TENDER NO. 24G/2009/10

CONTRACT DOCUMENT

FOR THE

DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING, AND COMMISSIONING OF THE IRT FARE SYSTEM, THE SUPPLY AND DISTRIBUTION OF FARE CARDS, AND THE PROVISION OF MAINTENANCE AND OTHER RELATED SERVICES

VOLUME 2B

(NON-RETURNABLE DOCUMENT)

SCOPE OF WORK, TECHNICAL REQUIREMENTS and SITE INFORMATION

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CIVIC CENTRE
HERTZOG BOULEVARD
CAPE TOWN

JULY 2009

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CITY OF CAPE TOWN

TRANSPORT ROADS & STORMWATER

CONTRACT NO. 24G/2009/10

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General Tender Information

This Volume 2B constitutes the balance of the Tender Document in accordance with F1.2 in Part T1.2 Tender Data on pages 4 and 5 of Volume 2, and is **not** returnable as stated in the foregoing clause and in F2.13.2 on page 7 of Volume 2A.

This Volume 2B contains 199 pages numbered:

- C3-1 to C3-44,
- C3.7-A1 to C3.7-A42,
- C3.7-B1 to C3.7-B12,
- C3.7-C1 to C3.7-C9,
- C3.7-D1 to C3.7-D31,
- C3.7-E1 to C3.7-E8,
- C3.7-F1 to C3.7-F10,
- C3.7-G1 to C3.7-G14,
- C3.7-H1 to C3.7-H15,
- C3.7-I1 to C3.7-I13, and
- C3.7-J1 to C3.7-J1.

in that order (refer to Declaration in Part C2.2 Schedules of Quantities in Volume 2A).

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DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING, AND COMMISSIONING OF THE IRT FARE SYSTEM, THE SUPPLY AND DISTRIBUTION OF FARE CARDS, AND THE PROVISION OF MAINTENANCE AND OTHER RELATED SERVICES

Structure of tender and contract documents

Volume 1 FIDIC Conditions of Contract for Plan and Design-Build
Volume 2A Returnable tender documents
Volume 2B Scope of Work, Detailed Specifications & Drawings (non-returnable document)
Volume 3 Drawings

Contents (Volume 2A – returnable document for technical offer and 2B – non-returnable)

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Part C3: Scope of Work

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Status

The Scope of Work constitutes the "Employer's Requirements" as defined in Sub-Clause 1.1.1.5 of the Particular Conditions in Part C1.2 Contract Data.

Should any requirement or provision in the parts of the Scope of Work conflict with any requirement of any Standardised Specification, particular specification or any drawings, the order of precedence, unless otherwise specified, is:

Scope of Work
Standardised Specifications
Drawings

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1 SECTION OBJECTIVE

The purpose of this section is to present the operational concepts for the City of Cape Town's IRT AFC System, from the perspective of the client, the contractor and the end user. The objective is to

- ensure the scope of the project is readily understood by Tenderers;
- provide transparency on the assumptions made in the preliminary design process;
- create awareness that the system must provide a seamless and intuitive operation for passengers, without anomalies or inconsistencies; and
- assist in understanding the relationship between the requirements of this tender and the needs of the end user.

2 PROJECT OVERVIEW

2.1 Procurement Objective

- The City of Cape Town requires an Automated Fare Collection System for access control and fare payment on its Integrated Rapid Transit System.
- Experienced and established suppliers are invited to present state-of-the-art technology-based solutions, which are proven and reliable in operation.
- It is envisaged that this Fare System will be flexible, scalable and easily expandable to facilitate interfacing and interoperability with adjacent intelligent transport systems.

2.2 Tender Synopsis

- The purpose of this section is to offer background information on the AFC System, in terms of the scope of requirements expected from the Fare System Contractor, and an indication of how the system is expected to operate. It is not in any way an exhaustive description of the requirements of the project.
    - Bidders should note that it is a work in progress, which may be amended and revised and updated from time to time, and must not be relied upon in isolation when preparing the tender response.
    - Where a discrepancy arises between any of the technical specifications, schedule of quantities or main agreement and this information summary, the latter does not take precedence.
- Once appointed, the Fare System Contractor will be required:
    - to supply (including design, procure, install, integrate, test and commission) the Fare System;
    - to initiate fare media distribution points within the retail environment,
    - to provide certain training and deliver manuals in respect of the Fare System;
    - to transfer ownership of the Fare System to the City (once the Fare System has been accepted by the City of Cape Town); and
    - thereafter to provide a set of defined Fare Services to the City.

2.3 Project Term

The Fare System will be designed, supplied, delivered, installed, tested and commissioned in two major phases, distinguished by scale of implementation rather than by level of functionality, as follows:

- 2010 FIFA Soccer World Cup (by May 2010)
    - Buses available:
        - 18m Trunk Buses – 17
        - 12m Trunk Buses – 42
        - 8.8m Feeder Buses – 61 (It should be noted by the contractor that only the Feeder Buses will have AFC equipment installed)
    - Routes to be operable (Refer to drawings in Volume 3)
        - All inner city feeder routes must be in operations
        - (AP) Airport Trunk route
        - (AT) Atlantis Trunk route
        - (BS) Bayside Trunk route

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        - (GB) Granger bay Trunk route
    - The following Stations will be completed and must have Access:
        - Granger Bay
        - Stadium
        - Civic
        - Airport
    - The following stations will also be completed by May 2010:
        - Woodstock, Paarden Eiland, Neptune, Section, Salt River, Zoar Vlei, Lagoon, Woodbridge Island, Links View, Racecourse Road, Sunset Beach, Bayside Centre, and the Atlantis Stations.
        - It is envisaged that these stations will be serviced by handheld AFC equipment initially due to time constraints. It is the responsibility of the Contractor to ensure that his programme reflects the operations, integration and delivery of these handheld devices accordingly.

The City has determined specifications (including technical and functional requirements) with which the Fare System must fully comply (including certain related obligations with which the Fare System Contractor must comply). Attention is drawn to the following Annexures in Volume 2B Part C3:

- Annexure A – AFC Technical Specifications
- Annexure G – Bank Issued Fare Media and Related Infrastructure
- Annexure I – NDoT AFC Data Structure

The remaining Annexures in Volume 2B Part C3 (as listed in Part C3.7 below) contain general specifications, with which the Fare System Contractor must comply insofar as they affect the solution being implemented.

The Fare System Contractor must complete the supply of the Fare System.

- The Fare System must be
    - fully installed, integrated and tested by the Fare System Contractor,
    - preliminarily accepted by the City and
    - accordingly ready for use
- Bidders are required to submit a proposed supply programme as part of their bids.

Due to the complexity of this IRT AFC System installation, the Client or the Client's Representative may consider on a three-monthly basis, a practical completion certificate in respect of interim handovers. The maintenance period for the hardware, software, and equipment will start after the practical completion, and will be measured by the Maintenance Service Level Agreement as per Annexure H.

2.4 AFC Regulations

The concept and strategic ideal of achieving so called integrated ticketing or multi modal travel can only be achieved if all technologies and systems implemented by all participating transport operators are truly interoperable. The City of Cape Town embraces the national vision for payment systems in public transport, and the principle of interoperability. In terms of general principles:

- Contribution towards common goals such as cash displacement and an integrated public transport network of services.
- Interoperability between fare systems and the minimisation of operating costs for its own Fare System.
- Endorsement of a system design which is founded on open standards, to achieve (and beneficially exploit) economies of scale, without recourse to closed or proprietary fare collection schemes
- Procurement of a solution which is proven, reliable, efficient, open and user-friendly, in similar style and operation to high quality metro public transport systems worldwide

In October 2008, the NDoT gazetted draft AFC Regulations, in terms of the National Land Transport Transition Act (NLTTA). Once they are promulgated, the regulations will regulate the use of electronic fare systems in public transport. On the basis of these regulations, the following principles are envisaged for the IRT AFC System:

- AFC must be made through any Bank Issued Fare Media;
- AFC must be interoperable through all Participating Banks;
- clearing and settlement of payment transactions must take place through the National Payment System in accordance with the National Payment System Act, 1998 (Act No. 78 of 1998);
- banked passengers must be able to use Bank Issued Fare Media obtained as a result of their relationship with any Participating Bank;
- unbanked passengers must be able to obtain prepaid stored value Bank Issued Fare Media from a Participating Bank or a third party card issuer operating in conjunction with the Participating Bank;

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- the payment system must adhere to the banking and payment regulatory framework;
- the AFC Data Structure must be loaded onto all Bank Issued Fare Media;

In respect of the transportation data system associated with AFC, the following principles are envisaged:

- public transport data must be collected electronically through the AFC System concurrently with the payment or redemption transaction;
- the relevant organ of state takes ownership of the data collected through the AFC System;
- data must be collected for planning and operational purposes, and must include data per transaction on location, fare and passenger;
- the database must enable the extraction of suitable data by the relevant organ of state for planning, monitoring, subsidy management and related purposes;
- the data system must comply with the MIOS for Information Systems in Government;

3 SCOPE OF SERVICES

3.1 Fare System Overview

- The primary mode of fare payment and access to the IRT is through contactless EMV Cards hosting the NDoT AFC Data Structure. In other words, it is envisaged that most passengers using IRT will use these cards to pay their fares. Fares may be paid in cash only in limited circumstances, namely on feeder vehicles.
- The Fare System facilitates
    - supply, activation and issue of the City of Cape Town IRT Card
    - contactless EMV fare payment transactions (such that the system will deduct the appropriate value from a Card each time the passenger uses the Card to access the IRT System
    - top-up of prepaid stored value or writing of a transit product (such as a day pass) onto the Card
    - inspection of cards by inspectors using handheld devices to verify that passengers have valid Cards and that they validated their Cards at the entrance to the Stations;
    - creation of records for each Fare System Transaction (for pay-as-you-go, product purchase and in exceptional cases on feeder vehicles, cash)
    - internet based services, for example ordering and payment for Cards, to be collected at the Station

3.2 Fare Payment Media

- **City of Cape Town IRT Card:** A bank issued contactless payment instrument that is
    - procured by the City of Cape Town and
    - design and brand approved by the City of Cape Town and
    - issued by the bank(s) included in the successful tender and
    - supported by banks that are members of the Payments Association of South Africa (PASA) and the relevant Payment Clearing House (PCH) and
    - based on EMV standards, conforming to Card Association specifications for contactless payments (MasterCard PayPass or Visa payWave) and
    - functions on the principle of pre-authorised debit and
    - conforming to the requirements of the AFC Data Structure as issued by the National Department of Transport.
- **Third Party Issued EMV Card**: A bank issued contactless payment instrument that is
    - procured and issued by an organisation other than the City of Cape Town and
    - supported by banks that are members of the Payments Association of South Africa (PASA) and the relevant Payment Clearing House (PCH) and
    - based on EMV standards, conforming to Card Association specifications for contactless payments (MasterCard PayPass or Visa payWave) and
    - functions on the principle of pre-authorised debit and
    - conforming to the requirements of the AFC Data Structure as issued by the National Department of Transport.

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- **Bank Issued EMV Card:** A bank issued contactless payment instrument that is
    - issued by a bank to its clients and
    - supported by banks that are members of the Payments Association of South Africa (PASA) and the relevant Payment Clearing House (PCH) and
    - based on EMV standards, conforming to Card Association specifications for contactless payments (MasterCard PayPass or Visa payWave) and
    - functions on the principle of pre-authorised debit and
    - conforming to the requirements of the AFC Data Structure as issued by the National Department of Transport.

3.3 Fare Services

- On completing supply of the Fare System to the City, the Fare System Contractor will be required to provide the following services over a remaining six year period
    - the supply and distribution of the City of Cape Town IRT Card (to endure sufficient supply at all times) to:
        - the Station Services Contractor; and
        - the Off-Station Distribution Network
    - the management of the Off-Station Distribution Network, such that the minimum footprint is sustained
    - scheduled maintenance for systems, software and cards are required
    - on-call repairs and replacement services
    - data transmission of transaction records (top-up transaction information to the relevant Issuing Bank and fare payment transactions to the City's Acquiring Bank)
- Passengers interact with the system using a bank issued contactless payment instrument.
- Any operational constraints introduced by this decision are outweighed by the efficiencies of running only one system, and the wider socioeconomic benefits conferred to the passenger.
- NDoT may implement an additional acceptance mark or identification decal, over and above that of the Card Associations, to create awareness regarding use in public transport.

4 PASSENGER VIEWPOINT

4.1 Identifying Options For Travel

- IRT will be actively promoted for travellers, not just for political or social milestones
    - Consider Gautrain "*for people on the move*", a message of enabling mobility
    - City will appoint marketing support for both the IRT System, and also for advice on the IRT Card.
- Good information is publically available to
    - help me plan a journey involving IRT;
    - advise on fares and products, along with any promotions or discounts;
    - inform me about how I can purchase travel, some additional information about the City of Cape Town IRT Card, (concept shift, not buying a ticket and not necessarily at a station); and
    - set the IRT in context with other modes, for example arriving at the airport, or hiring a bicycle around the City.
- Information might be accessed through a website, various route maps, link with tourist information, and articles in local media.
- Additional awareness created through separate marketing of interoperability through contactless payment instruments.

4.2 Purchasing Access

- *What can be purchased at a CoCT IRT Station?*
    - I can purchase a City of Cape Town IRT Card, which will be activated for me.
        - I may be supplied with a sealed PIN Mailer envelope containing the card PIN or given a default PIN to be changed to a personally selected PIN at time of activation.

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        - I can load value using the PIN with the contact chip interface by using a loading terminal device at the station
        - I can purchase a fare transit product, to be written onto the card, for example a Weekly Pass. Product purchases are exclusive to the IRT Station.
    - I can place a deposit for a 'single journey' card, use up the minimum fare value in a single journey, and return the card along with the deposit slip for a refund. Process may be a little bureaucratic in order to discourage regular use.
- *What can be purchased at Local Retailers advertising IRT?*
    - Some local retailers will also be selling CoCT IRT Cards "over the counter", as authorised (and potentially managed) by the relevant issuing bank or third party System Operator. If I purchase a card in this way, it also needs to be activated, and a PIN is needed to allow loading of value.
    - Some local retailers will be selling equivalent contactless cards, but issued by a third party other than the CoCT. Such cards may also have specific loyalty schemes, and as a consumer I am free to evaluate which card best suits my current taste or requirement (the outcome in terms of access to travel is the same).
- *How else can I obtain such cards?*
    - *Through a vending machine.* Vending machines are provided at selected stations in order to maximise customer convenience and minimise waiting times at kiosks.
        - For security reasons, no value will be preloaded on cards obtained from vending machines.
        - However, the City may choose to provide a simple product (for example one return trip, written on the unsecured data area of the card). This would be reflected in the purchase price at the vending machine, and would provide me with the convenience of first taking my trip and then activating my card and loading value later at my convenience.
    - *Directly from my bank.* As a banked customer, I may receive an upgraded card (contactless EMV) from my current bank(s), which also functions on the principle of pre-authorised debit and may be linked to my account. This provides additional opportunities for topping up, for example using an appropriately upgraded ATM.

4.3 Day To Day

- Fixed Costs and Deposits
    - I will be required to purchase a card. Each issuer will determine a competitive price for the card. City will decide whether a minimum R15 is charged, or whether the full cost of the card (say R30) is passed on.
    - In the special case of a single trip, the user may be issued with a different coloured card that is loaded with sufficient value for one journey.
    - A deposit of say R20 could be taken and then returned in exchange for the card one the journey is used. City would need to determine appropriate procedure for this type of card.

- Topping Up
    - *Load value using cash?*
        - A significant proportion of passengers will prefer using cash
        - Depending on the cash management regimes in place, the City may also wish to deter the accumulation of cash at the stations.
        - The City may wish to influence the level of activity at the stations, for example more focused on product sales rather than on loading value.
        - Banks and third party System Operators are responsible for determining their own fee structure.
    - *Load value using debit or credit card?*
        - Banks and third party System Operators are responsible for determining their own fee structure.
        - Fees should be known and competitive.

4.4 Difficulties Encountered

- ***Can I get a refund?***
    - *Can value loaded onto the card be refunded as cash?* No cash redemption from the card will be allowed in the retail or transport environment. However, redemption of unspent value for cash can be obtained from the issuing bank by presenting an acceptable form of identification

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- *Can a product loaded onto the card be refunded as cash?* As this is a product, then the City must determine the appropriate business rule for giving a refund on a product. Users must be given clear expectations when making the purchase, for example from the moment they first use a 'Seven Day Pass' it becomes non-refundable.
- *Can I receive any value back if I tapped accidentally or if I changed my mind?* Commuters will be able to receive any deduction from the card either through accident or change-of-mind. This value will however only be indicated on the card at a later stage when the card is inserted into a vending machine or point-of-sale.

- ***What if I have no value on my card?***
  - *No value on my card?* If I have a valid product on my card, I can still travel. Otherwise I can top up at the station or at a nearby retail outlet.
  - *No value on my card and travelling outside of normal retail hours?* The feeder bus will accept cash (correct change only) for a single ride. Cash fare will be higher than the electronic fare, to reflect additional risks of handling cash.
  - *No value on my card and no cash available?* I must seek an alternative mode of transport. Precedent already set by informal public transport, nobody rides for free.
- ***What if my card doesn't work?***
  - *Can't load value onto the card?* PIN might be incorrect, either due to fraudulent use or because the user has forgotten it. Contact card issuer using details provided on the card.
  - *Value (or valid product) on the card, but can't access gate?* Check balance using portable validator or nearby value loading devices. Check card is being placed in proximity to the reader on the gate. Otherwise, contact the Call Centre using details provided on the card.
- ***What if the gate or reader isn't working?***
  - *Gate is not functioning?* Station supervisor determines that the gate is faulty, and either redirects passengers to another gate or sets the gate to open and uses portable validator to monitor access instead.
  - *On board validator not working?* Operationally, the vehicle should return to the depot and repairs initiated. As a temporary measure, personnel with portable validators may board the vehicle.

4.5 Customer Assistance

- Public would access the call centre through a single (well marketed) number, appearing on IRT Literature, on Stations and Vehicles, and also on the CoCT IRT Card. Caller would be assisted as follows:
  - for cards issued by banks directly to their own customers, the caller can be directed to that issuing bank
  - for 'anonymous cards' the caller needs to identify whether it is a CoCT IRT Card or a Third Party Card
    - for the CoCT IRT Card, some additional support may be available within the call centre, and a set of business rules in place on how to handle or replace faulty cards (depending on the age of the card, visible wear and tear and so on).
    - for Third Party Cards, the caller may be directed to contact either the entity branded on the card (for example 'the ABC Store Commuter Card') or to look for a helpline number on the reverse of the card. Call centre will need some standard script to explain this difference to the public.
  - for IRT queries (timetable, routes, hours of operation, fares, discounts, operating status and so on), the caller should be able to obtain information with minimal redirection
  - a recorded message option should be included, with basic information that would satisfy a large proportion of callers.
- Some call traffic and functionality may be diverted to the internet instead
- Station Services Contractor will handle sale, activation and loading of new cards with product, and also with value.
- Alternative vendors for purchase, activation and value loading have been described above.

4.6 Miscellaneous Questions

- *What is the benefit of having a contactless EMV with the AFC Data Structure on it?*
  - Convergence on one card, you can use it as a cash equivalent for small value retail purchases and for travel on numerous modes.
  - AFC Data Structure should mean you get the best possible fare on those public transport systems that comply with the Department of Transport Regulations on Automated Fare Collection.

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    - Depending on the issuer, the card may also come with a loyalty scheme or preloaded products.
    - Allows for quick throughput of large volumes of passengers through access gates, without requiring insertion of card and PIN authentication
- *Will value be deducted if I get too close to the gate?* No, the card has to be placed deliberately in close proximity to the reader. The expression 'contactless' is in contrast to the lengthy 'contact' process of inserting the card into a reader and verifying with a PIN.
- *What if somebody steals my card or I lose it?* Card must be treated like cash, handled discreetly and kept in a safe place. A stolen or lost card can be locked remotely, and after an elapsed period of time to allow for clearing of transactions in the system, clients can be refunded, provided it is not an anonymous card

5 SYSTEM OPERATION

5.1 General Comments

- Fares and products for the IRT are determined by the City of Cape Town, and may vary from time to time.
- Relevant information is downloaded from the Central Information System to the gates and validators on a daily basis.
- Users interact with the system using an EMV Contactless Smart Card, issued by a PASA member bank, conforming to the Card Association Standards and hosting the NDoT AFC Data Structure.
- Passengers with contactless EMV cards issued outside of South Africa will not be able to use them as fare media at this stage. However they can easily use such cards to purchase a City of Cape Town IRT Card (or equivalent third party issued card).

5.2 Transaction Handling

- Fare Payment Devices must send all transaction records securely to the Acquiring Bank
    - Secure transmission required
    - Transactions may be batched to ensure efficient use of communications network
    - Secondary (anonymous) information about the transaction will be retained by the AFC Central Information System, such as
        - Location that transaction occurred
        - Type of transaction (cash or contactless)
- All records must comply with all applicable banking and payment standards.
    - Fare System Contractor must guarantee that transactions can be acquired by the bank appointed to the role of City's Bank.
    - Fare System Contractor must adapt the fare payment subsystem to accommodate any acquirer bank appointed by the City during the term of the Agreement. Such adaptations shall be completed at no additional cost to the City

5.3 Trunk Vehicles

- Users enter the station through access gates, and board without further validation once the vehicle arrives (this minimises the vehicle dwell time in the station).
- Users exit the station through access gates
    - If a valid product has been detected, no further action is needed
    - If no product is available, a transaction is processed based on the calculated distance between origin and destination, along with other factors such as time spent in the system.
    - Utilisation of pre-authorised debit on the card ensures minimum transaction time.

5.4 Feeder Vehicles

- Users boarding a feeder bus must tap their cards on the validator and receive acknowledgement of 'flat fare deduction' before boarding.
- In the absence of a valid card, the user may still proceed with a journey if cash is placed in the special on board collecting device.

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- Location of feeder buses is monitored by the Control Centre, for the purpose of scheduling, fleet management, and security. Information about the number of people boarding at each location (passenger demands), along with an indication of payment method (cash or card validation) must be sent back to the Central Information System.
- When the feeder vehicle arrives at a trunk (closed) station, passengers can exit from the door on the right

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C3.2 Engineering Design

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1 IRT DESIGN FRAMEWORK

This section provides the conceptual framework used in the development of the Schedule of Quantities, in order to facilitate understanding of the scope and nature of the information required in each section.

For the avoidance of doubt, please refer to The AFC System is designed to be aligned with the forthcoming government regulations. Hence any other smart card technologies outside the compliance to the government regulations shall be considered as non-compliance to the tender and their tender will not be considered.

1.1 *Modular Framework*

The Schedule of Quantities is divided into 12 different Schedules. These different Schedules are as follows:

1.1.1 Preliminary and General Items

All overheads and expenses related to:

- site/main office,
- occupational health and safety,
- insurance,
- design, and
- management.

1.1.2 Fare Media

All costs associated with the fare media, its personalisation, issuance, distribution, and the equipment related to these functions.

This section also includes the Card Vending Machines, and the Mobile Handheld devices. It is important to notice that the Contractor is responsible for coordinated discussions with the Client or his Representative for the design of the Fare Media artwork.

It is also the responsibility of the Contractor to enter negotiations with retail outlets for the purpose of reselling City of Cape Town IRT Cards at these outlets. It is the responsibility of the Contractor to indicate his plan to the Client or Client's Representative for a retail outlet footprint.

Fare Media shall be of the specified type (Multos I4F), other EMV certified cards with the NDoT AFC Data Structure capability can be presented by the Contractor to the Client or the Client's Representative for discretion.

Detailed requirements are set out in Part C3 Annexure G "Bank Issued Fare Media".

1.1.3 Fare Access Control System

All costs associated for providing installed and functioning access gates with integrated fare readers, and fare processors.

It should be noted that the access gates, fare readers, and processors should be considered individual components even if assembled within the access gate manufacturer's premises.

The Contractor is encouraged to provide for different types of access gate technologies if it is capable of doing so. Due to space constraints the 3.5m wide stations (refer to the Station Matrixes, the available usable width is 2436mm) requires a minimum of two access gates, with one gate being of universal access (wheelchair friendly) type. To facilitate this design, an access gate cabinet width of 155mm is required to have two access gates in place. The Contractor is more than welcome to propose other alternatives. Exuberant costs will have to be explained.

1.1.4 Communications Infrastructure

All costs associated for providing communications from the Server Rack (that will be supplied by others) to the access gates, card vending machines, mobile handhelds, servers, operator terminals, vehicles, and telephones. The Contractor should note that some stations require fibre optic connections between server racks and field equipment as the distances are over 100m between these elements.

Primary communications is provided by others. Primary communication entails that the Contractor will be given a single RJ45 connection with a guaranteed bandwidth of 25MB/s within a secure VLAN at each IRT Station. This communication is considered to be redundant in nature through physical separation of redundancy and primary links, as well as logical redundancy through the use of protocols such as the Rapid Spanning Tree Protocol (RSTP).

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However, as financial transactions are being handled that are not yet part of the City's coffers, secondary communications measures must be provided by the contractor in the form of GPRS or 3G cellular technologies (depending upon coverage). Where signal strength is limited, additional antenna need to be procured.

Each station will have a WiFi access point to facilitate the communications between the vehicles, and the handheld devices. This WiFi to LAN connection will be considered as the primary communications medium for the vehicles and the handheld devices with the secondary communications channels being GPRS or 3G.

1.1.5 Vehicle Equipment

All costs associated for providing fare reading equipment onboard a vehicle. Only the feeder vehicles are considered to have fare equipment, as the remaining trunk vehicles will be part of a "closed system" where as commuters can only enter and exit through access gates. Where free admittance are considered from feeder to trunk routes, the logical switch on the fare media will happen through the additions of access gates within a closed system.

It should be noted that the primary communications mechanism must be the WiFi access at each station, and the secondary communications mechanism be the GPRS or 3G to reduce operational costs.

The feeder vehicle equipment also includes a Cashbox through which the commuter will pay his/her fare and receive a receipt. The policy of the City of Cape Town is that the driver should not handle cash. No value loading onto the fare media shall be done on a vehicle.

1.1.6 Man Machine Interface Equipment

This is all the general man machine interface equipment such as Thin Clients, Printers, and Sounders/Strobes (If required). The Contractor is allowed to propose other hardware. All Information and Communication Technology (ICT) equipment shall be compliant to the ICT Specification Annexure and needs to be fit for purpose.

1.1.7 Data Processing Equipment

This is all the server related equipment, firewalls, mounting equipment, and software. Although specific HP equipment was specified, it is only for information purposes, for the Contractor to determine the minimum specifications. All Information and Communication Technology (ICT) equipment shall be compliant to the ICT Specification Annexure and needs to be fit for purpose.

The Data Processing Equipment also includes a UPS that needs to be connected to mains power to determine if the power has been removed or not, for purposes of graceful shutdown of the electronic equipment after a certain period of time.

1.1.8 Electrical Infrastructure

The main power supply will be done by others to an Electrical Distribution Board. Power will be made available in the form of UPS power protected with Class III fine voltage protection. Reticulation from the Distribution Board to the field devices is the responsibility of the Contractor. All devices must have dual pole protection as specified. Allowance has been made for additional Distribution Boards in the event that a DB is fully occupied, however, it is foreseen that these will be unnecessary.

1.1.9 Integration: Control and Operations Software

This includes all the software components/modules that is required for the AFC system to function as specified within the Scope of Work and the Annexes and their integration into a cohesive system. These include but are not limited to:

- Fare Rules System Software
    - Flat Fare System Rules Software
    - Differentiated Fare System Rules Software
- Access Control System Software
- Card Vending Machine System Software
- Vehicle Validator System Software
- Point-of-Sale System Software
- Handheld Validator System Software
- Data Server System Software
- Audit/Reporting Server System Software
- Third-Party Transit Product Issuance Gateway Software
- AFC Website Software
- Central Fare Management System Software (Central point of Integration)

1.1.10 Training

Thorough training must be provided by the Contractor in a structured and documented manner to the Station Services Contract Employees that will be supplied by others. This training should cover from basic IT skills to full system diagnostics and support functions.

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Continues training shall be given by the Back Office personnel, which is supplied by the Contractor, after the initial training provided by the Contractor.

1.1.11 Operations

It is envisaged that a team of four (4) senior management employees and six (6) junior management employees be catered for by the Contractor to ensure fare media stock management and service level agreement obligations.

It should be noted that the Contractor must price for years one (1) to six (6).

1.1.12 Maintenance

Maintenance according to the service level agreement as per the annexure should be catered for. These are lump sums and must include all the requirements as stipulated by the annexure.

It should be noted that the Contractor must price for years one (1) to six (6).

1.2 Station Matrixes

The following is a brief summary to the stations, and their AFC equipment requirements:

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Station name	Station Type	Station Length	REQUIRED 1 POS	REQUIRED 2 POS	REQUIRED 4 POS	REQUIRED CVM	AVAILABLE WIDTH (m)	MINIMUM REQUIRED STANDARD	MINIMUM REQUIRED UNIVERSAL
PHASE 1A - A, TO BE COMPLETED BEFORE WORLD CUP:									
Granger Bay	E_2	44m	0	1	0	0	3548	2	1
Airport	O	73m	0	1	0	1	n/a	0	6
Civic Centre	H	125 m	0	2	0	1	n/a	12	6
Thibault Square	C2	103 m	0	1	0	1	3786	6	2
Stadium	K	166m	0	0	1	1	n/a	10	4
2010: TOTALS			0	5	1	4		30	19
PASE 1A - A, TO BE COMPLETED AFTER WORLD CUP:									
Atlantis Town Centre	T	103 m	0	1	0	0	3786	5	2
Neil Hare	E_1	103 m	1	0	0	0	2286	0	2
Gardenia	E_1	103 m	1	0	0	0	2286	0	2
Atlantis Industrial	E_1	103 m	1	0	0	0	2286	0	2
Bayside Centre	C_1	103 m	0	1	0	1	3786	6	2
Sunset Beach	B_1	46 m	1	0	0	0	2286	0	2
Racecourse Road	B_1	46 m	1	0	0	0	2286	0	2
Links View	B_1	46 m	1	0	0	0	2286	0	2
Woodbridge Island	B_1	46 m	1	0	0	0	2286	0	2
Lagoon	B_1	46 m	1	0	0	0	2286	0	2
Zoar Vlei	B_1	46 m	1	0	0	0	2286	0	2
Salt River Canal	A	83 m	1	0	0	0	2286	0	2
Section	A	83 m	1	0	0	0	2286	0	2
Neptune	A	83 m	1	0	0	0	2286	0	2
Paarden Eiland	A	83 m	1	0	0	0	2286	0	2
Woodstock	G	155 m	0	1	0	1	2286	2	3
PHASE 1A - A: TOTALS			13	13	2	10		73	71
PHASE 1A - B:									
Sandown	B_1	46 m	1	0	0	0	2286	0	2
Sunningdale	B_1	46 m	1	0	0	0	2286	0	2
Portside	J	78m	0	2	0	1	n/a	5	2
Vlei Road	R		1	0	0	0	2286	0	2
Rocklands Bay	B_3	56m	1	0	0	0	2286	0	2
Three Anchor Bay	B_3	56m	1	0	0	0	2286	0	2
London Hall	B_3	56m	1	0	0	0	2286	0	2
Milton's Pool	B_3	56m	1	0	0	0	2286	0	2
Sea Point Pavillion	B_3	56m	1	0	0	0	2286	0	2
Queens Beach	Q	123m	1	0	0	1	2286	0	6
Camps Bay	S	46m	1	0	0	0	2286	0	2
Victoria Wharf	B_2	90m	1	0	0	0	2286	0	2
Adderley	L	86m	0	2	0	0	3786	6	2
Gardens Centre	N	9m	0	1	0	0	n/a	4	2
Doornbach	A	83 m	1	0	0	0	2286	0	2
Dunoon	A	83 m	1	0	0	0	2286	0	2
Sati	A	83 m	1	0	0	0	2286	0	2
Killarney Racetrack	A	83 m	1	0	0	0	2286	0	2
Killarney Gardens	A	83 m	1	0	0	0	2286	0	2
Diep Rivier	D	98 m	1	0	0	0	2286	0	2
Boy De Goede	F_3	46 m	2	0	0	0	2286	0	4
Wood Drive	F_1	46 m	1	0	0	0	2286	0	4
Flamingo Vlei	F_2	46 m	2	0	0	0	2286	0	4
Table View	F_2	46 m	2	0	0	0	2286	0	4
Bayside - Closed Feeder	B_1	46m	1	0	0	0	2286	0	2
PHASE 1A - B: TOTALS			25	5	0	2		15	62
PHASE 1A: TOTALS			38	18	2	12		88	133

Table 1: Summarised Station Matrix

Table 1 is accurate when the document went to print. See IRT Station Matrix on Compact Disc.

1.3 Block Diagrams

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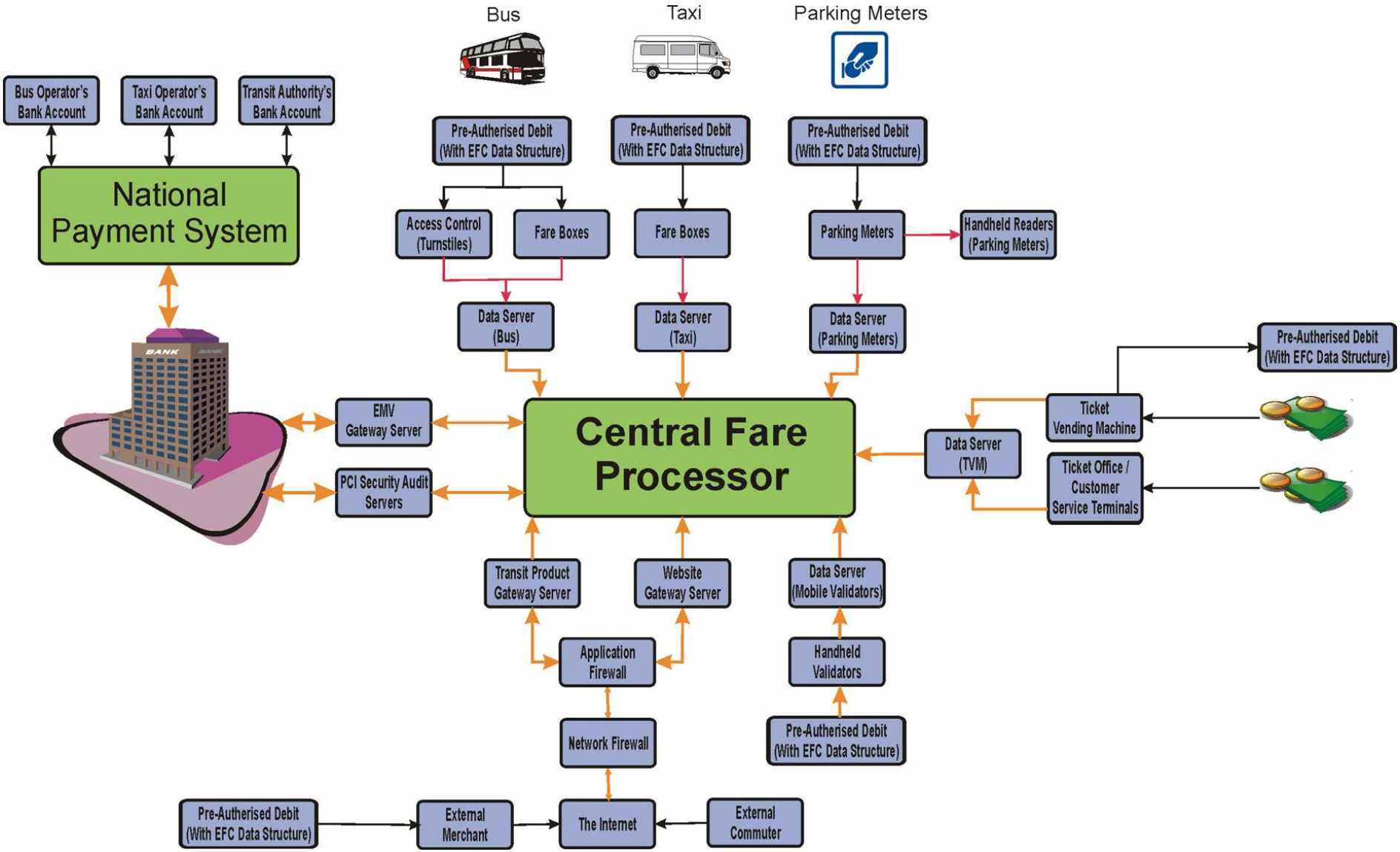

Figure 1: Schematic envisaged architecture of the final solution

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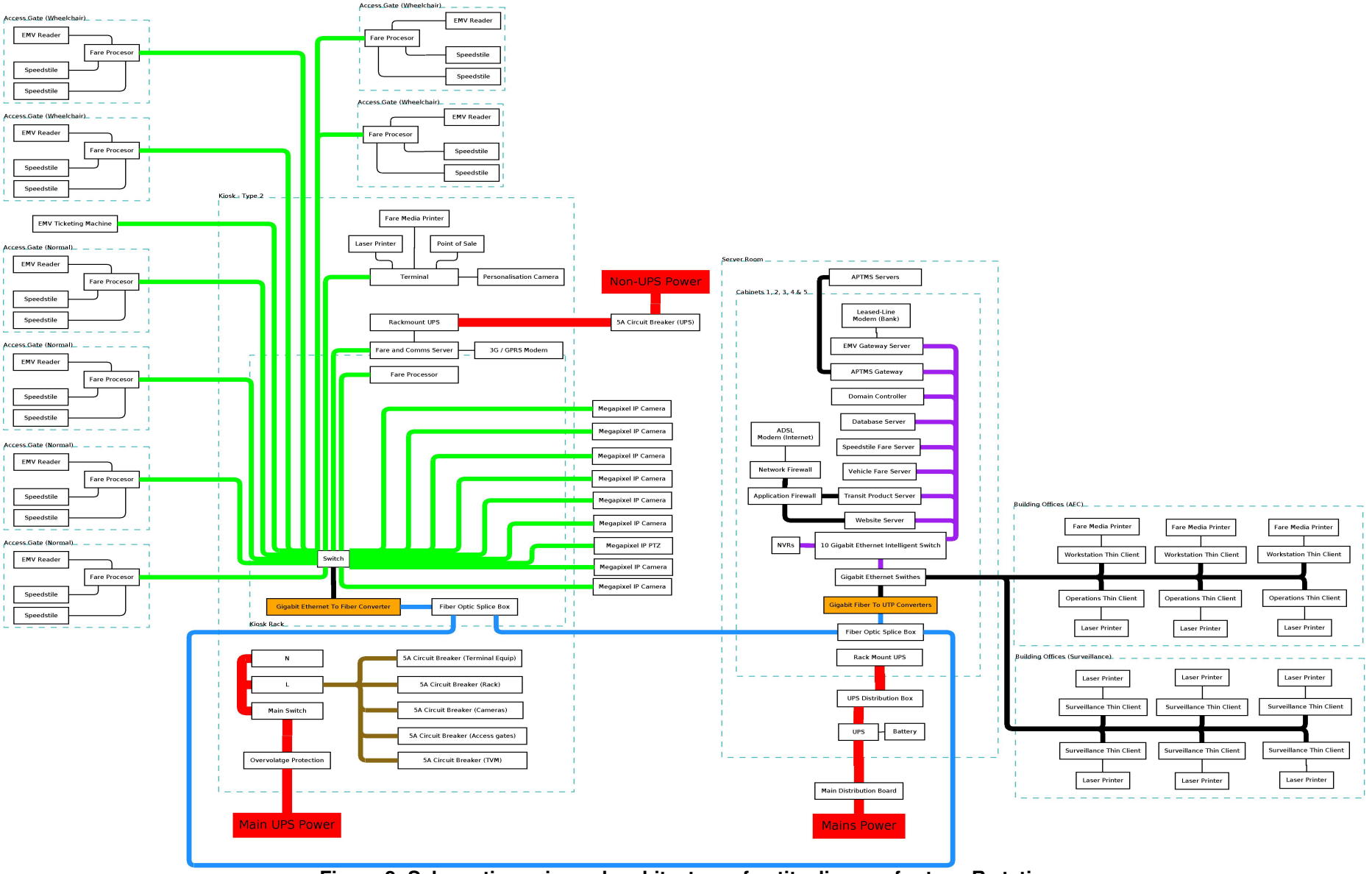

Figure 2: Schematic envisaged architecture of entity diagram for type R station

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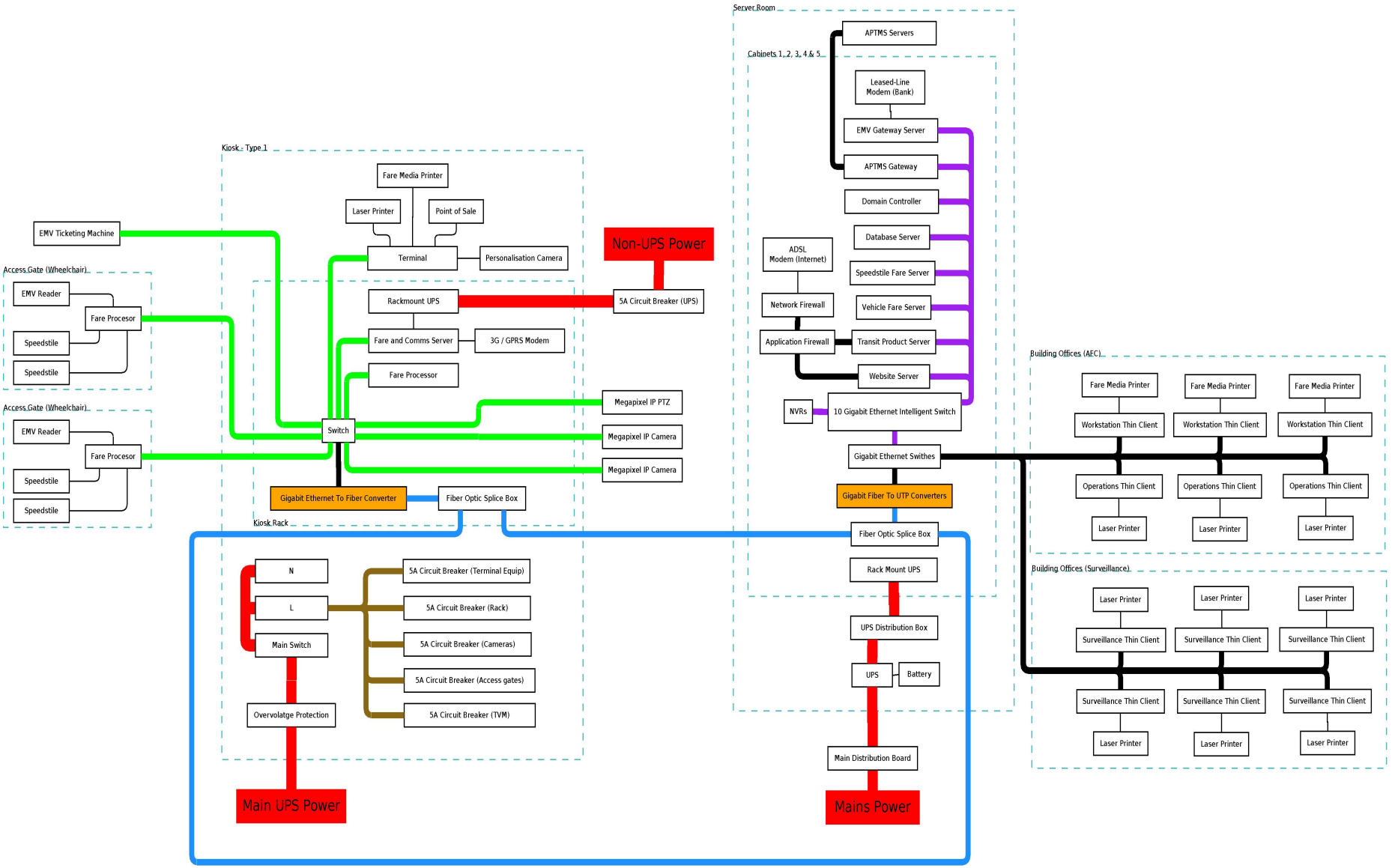

Figure 3: Schematic envisaged architecture of entity diagram for type B1 station

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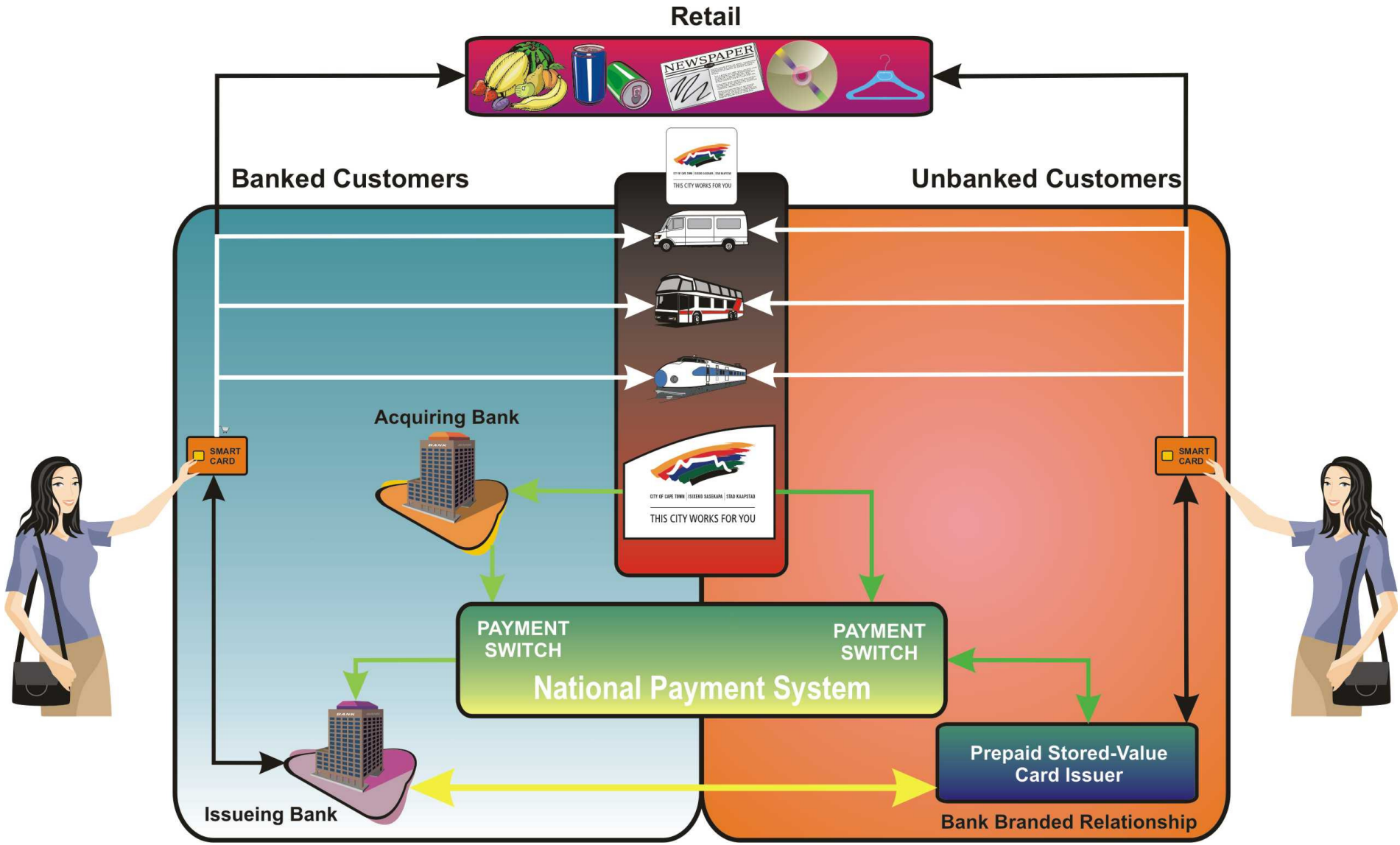

Figure 4: Schematic of difference between Banked and Unbanked Commuter

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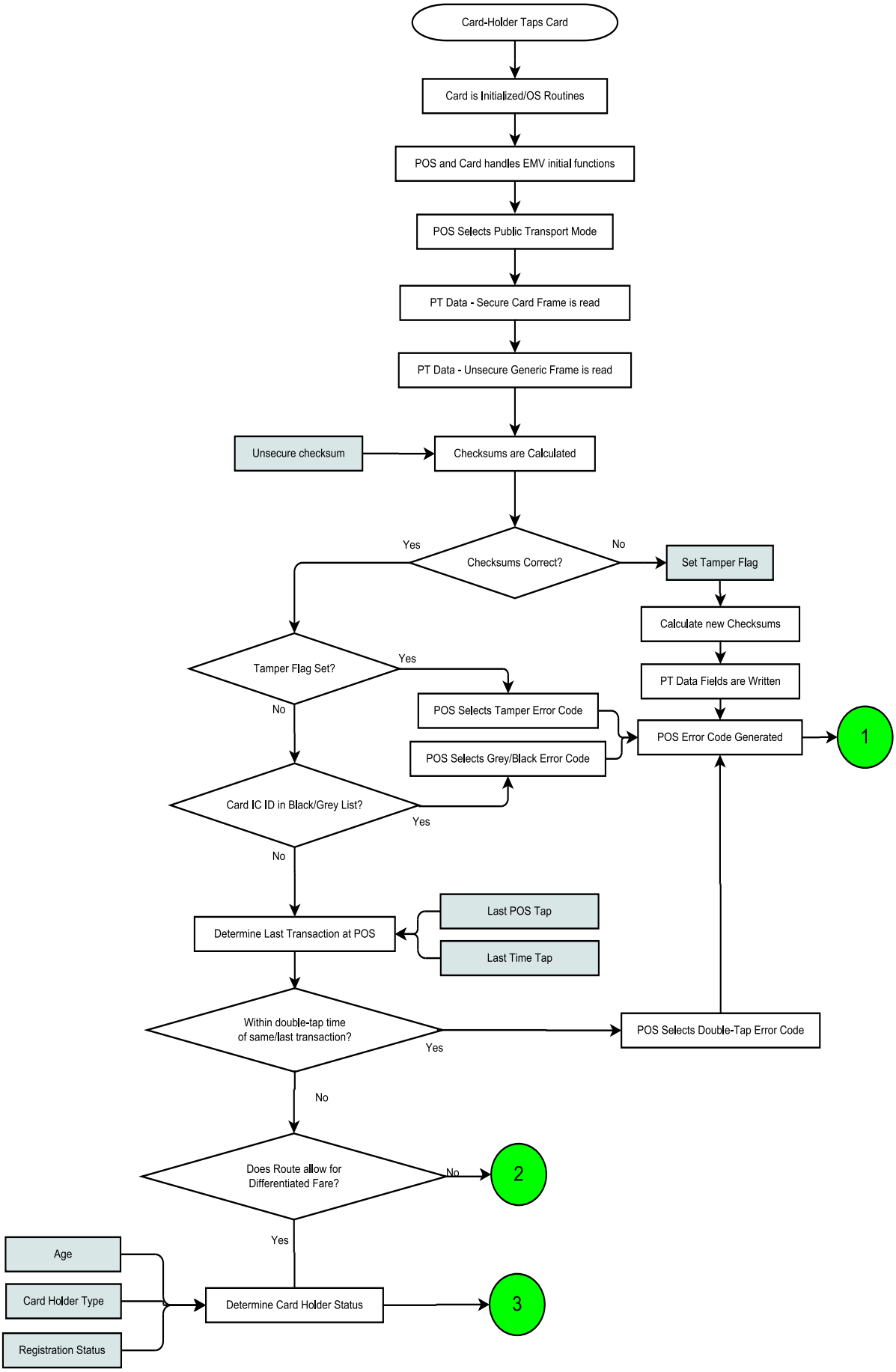

Figure 5: Envisaged final Fare Structure solution capability -1 of 5

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A test bench is a virtual environment used to verify the correctness or soundness of a design or model. Thus the following fare test bench have been created to facilitate the fit for purpose measurement to determine what types of fare structure and regimes the proposed data structure conforms to, if any. The fare test bench indicates the ability of the proposed fare data structure. The fare test bench is a logical flow diagram and is visible in **Error! Reference source not found.** , **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.**, and **Error! Reference source not found.**. A brief description will follow each flow diagram to discuss the possible outcome of the test bench.

The Secure Card Data Frame will be read automatically by the Point-of-sale device, at the position of the public transport data read within the EMV process, the Point-of-sale device will have determine if it requires to read additional information beyond the Unsecure Generic Data Frame. If there are transit products within the Data Structure that is used, additional Data Frames will also be read at this position in the process flow. All the computations for the fare regime will be calculated after the data has been made available. Updated Data Blocks will be submitted at the end of the transaction.

With reference to **Error! Reference source not found.** of the Fare Test Bench. The commuter will tap his/her smart card at a point-of-sale device. Within this context it is assumed that the point-of-sale device will handle the EMV and Transit functions within one device, although this may differ in practise. All required EMV transactions will be issued first. For the purposes of this example, the Secure Card Data Block will be read as part of this Test Bench instead of the proposed solution where the Secure Card Data Block will be read automatically at card presence before any application selection or EMV transactions start.

At this point, the Unsecure Generic Card Block is read. As indicate this Data Block contains the tap-on/tap-off information. Before any transactions occur the Message Authentication Code checksums are calculated to determine if any un-solicited access have taken place. If the point-of-sale determines that the card has been tampered with, a tamper flag will be set, and the relevant card data blocks will be written back to the card. An error code will be generated on the point-of-sale to indicate to the commuter and nearby standing personnel that the smart card will not be able to be used again while the tamper flag is set.

Thus will then require the commuter to take his/her smart card to a kiosk attendant for the purposes of resetting the card's tamper flag and to determine if this is a recurring event with the smart card / commuter. If the checksums computed and compared correctly with the Unsecure Generic Data Block, the tamper flag will be checked to determine if the card have failed a previous checksum. If this is the case, then the point-of-sale will generated a specific error code indicating the card has been tampered with and terminate the transaction.

The point-of-sale will then further determine if the card is part of a black list. If this is the case the point-of-sale will generated a blacklist warning code for nearby security personnel, and the transaction will be terminated. The point-of-sale will determine where and when last the smart card was used, if the smart card indicates it was last used on the specific point-of-sale device, and it is within the double tap time, either by accident or on purpose, the point-of-sale will generate an error code indicating to the commuter that it will not deduct any additional value (or in access control environment enforce single entrants), as the commuter has already paid for the transaction.

Several business rules can be connected as part of this process, where as parents can double tap within a certain time for their dependants, to allow minors to travel with their parents on single smart card. If the point-of-sale passed all of the fare structure tests to this point, the point-of-sale will determine if it allows for flat fares only or if it can accommodate differentiated fare structures. Depending of the fare regime, the point-of-sale will start either through the flat fare process or the differentiated fare process.

With reference to **Error! Reference source not found.** of the Fare Test Bench. This part of the test bench focuses on the main transit product based differentiated section of the fare test bench. A commuter is required to register for these transit products, if the commuter is indicated as being of an unregistered type, the point-of-sale will switch to the distance based calculations part of the test bench. If there are no operator codes that the point-of-sale recognise it will switch to the distance based calculations section of the test bench. It is envisaged that transit operators will create transit products to attract commuters to their respective services or routes. If the point-of-sale do recognise the operator codes, it will iterate through each of the Secure Value Data Frames to determine if it is:

- a valid product,
- a unlimited pass type product,
- a limited pass type product, or
- a fare based product.

If there are no products that can be used, the point-of-sale will switch to the distance based calculations section of the test bench. However, if there are valid products that will be used, the first product available will be used. The argument for letting commuters select which product to use will only delay the throughput of such a system, and would require the commuter to keep his/her smart card within coupling proximity the whole time. A priority level can be added to the point-of-sale's selection criteria of the different products. If an unlimited pass transit product was found, the commuter will be allowed access. If a limited pass transit product was found and there remains

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usage on the product, the usage counter will be increased/decreased and the commuter will be allowed access. If the usage limit on the product has been reached, then the point-of-sale will switch to the distance based calculations section of the test bench. If a fare based transit product was found, a certain amount of discount can be added to cost of the trip. The point-of-sale will then continue to determine the trip amount based upon the calculations of the distance based calculations section of the test bench.

With reference to **Error! Reference source not found.** of the Fare Test Bench. This part of the test bench calculates the distance based fare regimes. The only transit product that has reference to this section is the fare based transit product which it is envisaged will only have a percentage based discount. The point-of-sale device will determine if the route on which it is currently traveling is zonal or distance based. Tap-on/tap-off information is then extracted from the Data Blocks to determine if the commuter is entering or leaving the public transport service. Additional checks is also done to determine if the commuter forgot to tap-off, where no additional access control infrastructure is located. If the commuter was not within the public transport service the minimum fare amount will be deducted as standard, and if he is within the system and is exiting the remainder will be calculated. If the commuter did forget to tap-off where no access control is in place a maximum fare amount will be deducted as penalty.

With reference to **Error! Reference source not found.** of the Fare Test Bench. This part of the test bench calculates any transfer incentives as well as any time-of-day impacts that might occur. A transport authority might select provide an incentive if a commuter uses a specific transport service before using this service or if the commuter is using the service during a certain period, either through time or days. The point-of-sale will firstly determine if it allows for transfers from another public transport service. If it does allow for transfers, and the commuter did come from a valid public transport service, the point-of-sale will calculate a discounted minimum fare.

If no discount is associated with the transfer, the point-of-sale will use the default minimum fare as the set fare amount. The point-of-sale will next determine if it allows for impact calculations based upon time-of-day or day specific incentives. If it does allow for impacts, it will calculate the accumulated fare amount based upon the impact associated for that time-of-day, or special day. It should be noted that the impact can be added or subtracted from the final value.

With reference to **Error! Reference source not found.** of the Fare Test Bench. This final section of the test bench determines any Quality of Service (QoS) based discounts/increase, adds any other percentage discounts based upon transit products, and finalises the transaction by executing the payment instructions, calculating new checksums and writing new values to the Data Blocks. QoS public transport services are the express type services and premium type offerings. The point-of-sale will determine if the service offered qualifies for the type of discount/increase and will calculate the new fare amount to be deducted.

If this type of services are not offered the fare amount does not change. If a transit product was used as part of a fare based offering the point-of-sale will calculate the percentage discount, else the fare amount will not change. The amount to be deducted will be passed onto the EMV bank function, and if successful, the point-of-sale will calculate the new checksums and write the new values to the Data Blocks back to the smart card and notifies the commuter of a successful transaction. If the transaction failed, the commuter will be notified by a error code via the point-of-sale.

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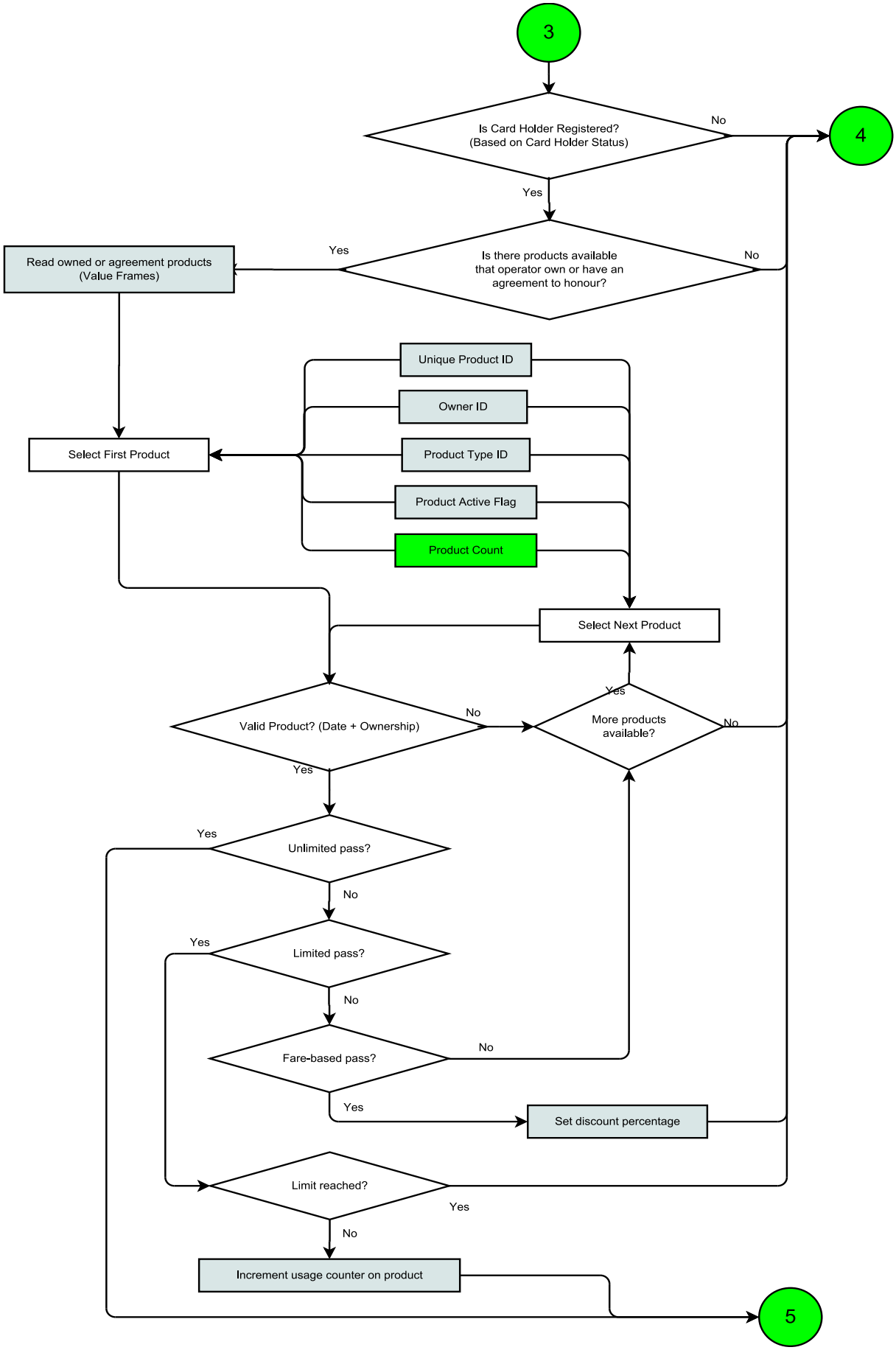

Figure 6: Envisaged final Fare Structure solution capability -2 of 5

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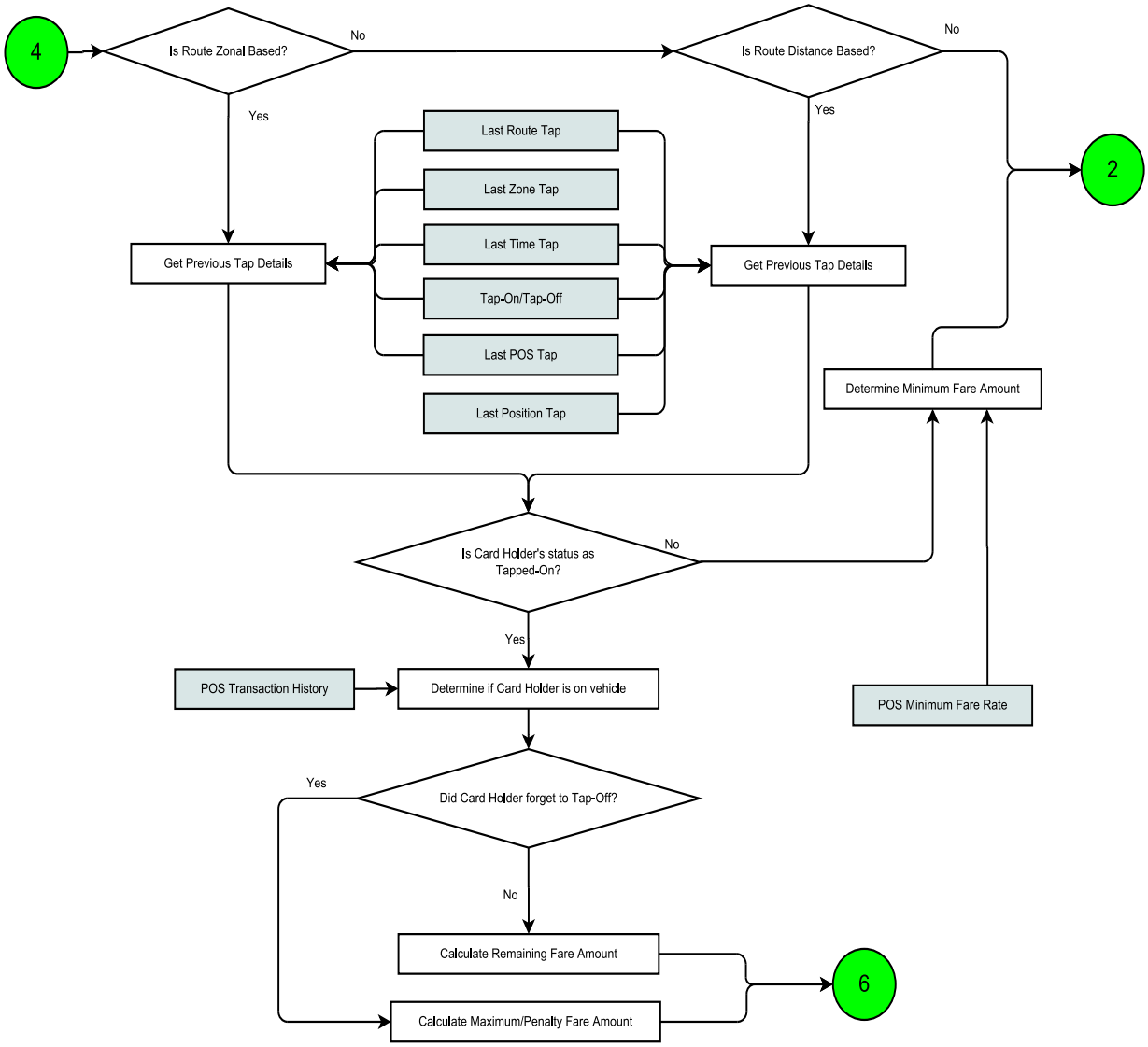

Figure 7: Envisaged final Fare Structure solution capability -3 of 5

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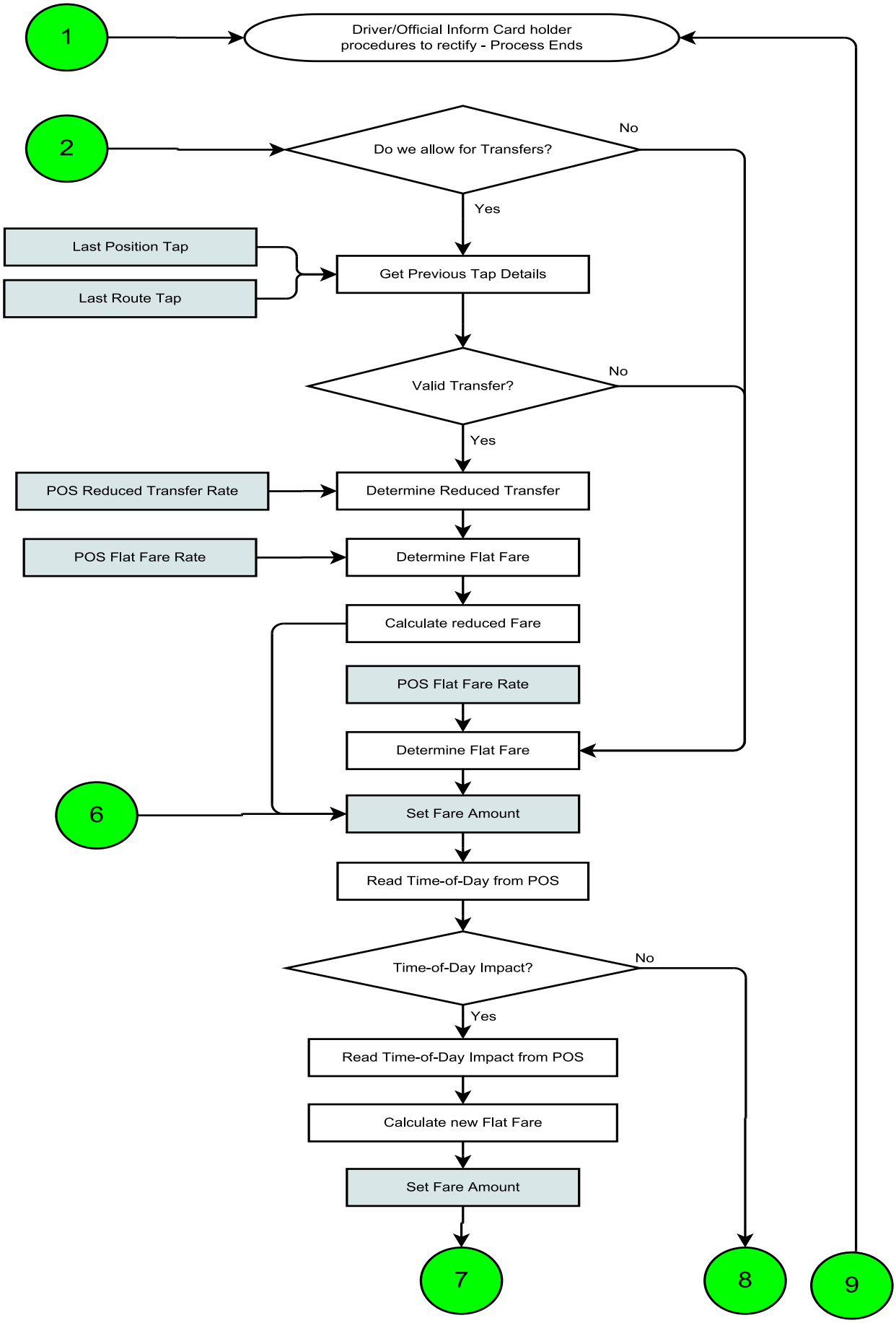

Figure 8: Envisaged final Fare Structure solution capability -4 of 5

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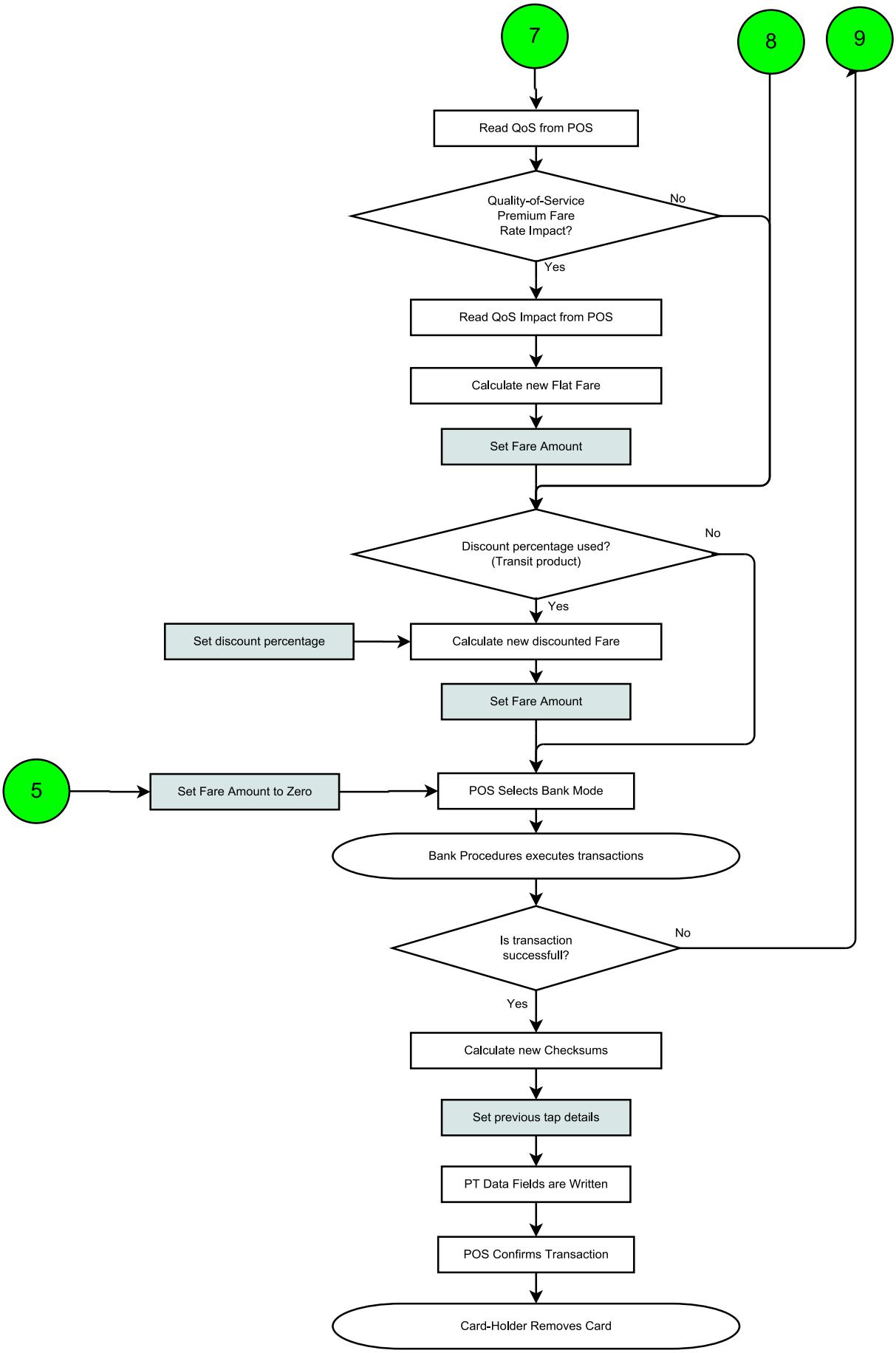

Figure 9: Envisaged final Fare Structure solution capability -5 of 5

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2 DRAWINGS ISSUED WITH THIS DOCUMENT

The following drawings are applicable to the contract and are issued with this tender document and will form part of the Contract Documents as **Volume 3**. These drawings are for information purposes only.

3 CONTRACTOR'S DOCUMENTS

The requirements relating to the information and drawings to be submitted by the Contractor for approval by the Engineer prior to the purchase and manufacture of any hardware and equipment must be read together with Clause 5 of the General Conditions and Sub-Clause 5.2 of the Particular Conditions.

All the documents listed below shall be submitted for approval by the Engineer.

3.1 General Requirements

Comprehensive documentation for all equipment, sub-systems and equipment (hardware and software) solutions shall be supplied. All documentation shall be promulgated under control of an industry standard document configuration management system (inclusive of document identification, revision control, release control and status accounting).

The Contractor's Documents shall comply with the following general requirements:

Ref #	Document (s)	Delivery deadline	Period Required for Approval
1	Project Programme	4 weeks following the date of the commencement of the contract.	1 week
2	System Design document	8 weeks following the date of commencement of the contract.	2 weeks
3	Operation and maintenance manuals for all hardware equipment	2 weeks before FAT of associated supplies (software or hardware)	2 weeks
4	Operation and administrator manuals for all software applications	2 weeks before FAT of associated supplies (software or hardware)	2 weeks
5	FAT Plan	4 weeks before first FAT	2 weeks
6	SAT Plan	4 weeks before first SAT	2 weeks
7	Equipment, sub-systems and systems level FAT and SAT documentation, including associated test result sheets	To be delivered with FAT and SAT plans respectively	2 weeks for equipment, 3 weeks for sub-systems, 4 weeks for system
8	Training Plan	2 weeks before associated training	2 weeks
9	Training manuals for users and administrators for all equipment and applications	2 weeks before associated training	2 weeks
10	Service Level Agreement (signed)	Part of Contract.	
11	As-Built Documentation	2 weeks after sign off of SAT.	2 weeks

Table 2: Documentation Requirements

3.2 Before Taking-Over Certificate

Before the Taking-Over Certificate is issued, the Contractor shall provide six copies of the final version of the Installation, Operation and Maintenance Manual and shall also provide, on electronic data storage, all drawings

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supplied in terms of the Required Submissions within 42 and 70 days above, corrected where necessary to be "as built". The drawings shall be configured for AutoCAD (DWG version 2010).

As-built (or As-installed) refers to the exact location, position, layout and configuration of installed supplies after a Site Acceptance Test (SAT). The Contractor shall provide “As built” documentation. An electronic copy (AutoCAD format) of all associated drawings shall be provided. As-built documentation shall include:

- Bills of Materiel (parts list) indicating model /versions numbers and (including modifications and customisations) for each installed site, including association with representative documentation associated with
- Equipment location drawings including "As Built" rack layouts and floor plans.
- Equipment configurations, set ups and level settings complete with tolerances allowed.

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CITY OF CAPE TOWN

TRANSPORT ROADS & STORMWATER

CONTRACT NO. 24G/2009/10

DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING, AND COMMISSIONING OF THE IRT FARE SYSTEM, THE SUPPLY AND DISTRIBUTION OF FARE CARDS, AND THE PROVISION OF MAINTENANCE AND OTHER RELATED SERVICES

C3.3 Procurement

CONTENTS **PAGE**

1 PREFERENTIAL PROCUREMENT PROCEDURES.....C3-33

2 SUBCONTRACTING C3-33

3 PROVISIONAL SUMS C3-33

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1 PREFERENTIAL PROCUREMENT PROCEDURES

The works shall be executed in accordance with the conditions attached to preferences granted in accordance with the Preferencing Schedule (Schedule 16 in Part T2.2 Returnable Schedules in the Tender Data)

2 SUBCONTRACTING

Not used.

3 PROVISIONAL SUMS

The Contractor is referred to Sub-Clause 13.5 in the General Conditions and in the Particular Conditions regarding the requirements for quotations.

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C3.4 Installation of the Works

CONTENTS **PAGE**

1 APPLICABLE STANDARDISED SPECIFICATIONS C3-35

2 PARTICULAR SPECIFICATIONS C3-35

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1 APPLICABLE STANDARDISED SPECIFICATIONS

For the purpose of this Contract the following Standard Specifications shall apply:

It shall be the responsibility of the Contractor to obtain, at his own expense, the most recent copies of the relevant editions of the documents referred to above.

The Contractor shall keep copies of the above Standard Specifications, copies which are available from the South African Bureau of Standards.

2 PARTICULAR SPECIFICATIONS

The following particular specifications are in this Volume 2B:

Specifications

A DETAILED SPECIFICATION FOR AFC WORKS (INCLUDING GENERAL WORKS)
B STANDARD SPECIFICATION FOR ELECTRICAL WORKS
C STANDARD SPECIFICATION FOR ELECTRONIC WORKS
D STANDARD SPECIFICATION FOR ICT WORKS
E STANDARD SPECIFICATION FOR FIBRE COMMUNICATIONS WORKS
F HEALTH AND SAFETY SPECIFICATION
G BANK ISSUED FARE MEDIA AND RELATED INFRASTRUCTURE SPECIFICATION
H MAINTENANCE SERVICE LEVEL SPECIFICATION
I NDOT AFC DATA STRUCTURE

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CITY OF CAPE TOWN

TRANSPORT ROADS & STORMWATER

CONTRACT NO. 24G/2009/10

DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING, COMMISSIONING, AND MAINTENANCE OF THE IRT AUTOMATED FARE COLLECTION HARDWARE AND SOFTWARE, AND PROVISION OF CERTAIN RELATED SERVICES

C3.5 Testing and Commissioning

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1 System Design Document

- The Contractor shall develop and submit a system design document detailing how the specifications are met. The Contractor shall schedule meetings with the Client or the Client's Representative to review and discuss the requirements stated in these specifications during the system design process. The Contractor shall document their system design, trace the design to the requirements, and submit the document for review, approval and sign off.
- The system design document shall detail the design of the system including operating principles, system features and functions, graphical user interfaces, operational workflow and dialogues, report formats, capacity, expandability, interconnections/interfaces between subsystems and with external entities. The Contractor shall identify any modifications to their offered hardware and customisation of their offered software required to meet the requirements stated in these specifications.
- The system design document shall include the technical specifications of all equipment and materials to be utilised.
- The Contractor shall submit the system design documentation, and schedule design review meetings to review the documentation submissions. Comments from the design review meetings and written responses shall be incorporated into the systems design document, and a final document issued for review, acceptance and sign off.

2 System Interfaces To Other ITS Systems

- The Contractor shall confirm the supplied systems comply with the interface specifications. The Contractor shall co-ordinate the work with the other ITS system contractors to confirm compliance to the interface specifications. The Contractor shall supply prototype interfaces for each inter-system interface to the other contractors as part of the integration process. At a minimum these interfaces should be standard web services based (see Part C3 Annexure D ICT Specifications).

3 Acceptance Tests

3.1 General

1) The Contractor shall:
    a) Perform testing and commissioning activities by stages in accordance with the requirements as set out in herein.
    b) Ensure the system, sub-systems and equipment are in a state ready for commissioning and testing before the commencement of the tests to be witnessed. The Contractor shall conduct his/her own trial tests to satisfy him/herself that the system satisfies the testing requirements before the client or client's representative is invited to witnessed the tests.
    c) Satisfy himself that all items interfacing to other Contractors are in satisfactory condition for the Contractor's tests to be carried out.
    d) Provide all necessary test instruments, special tools, emulators, simulators and test software to carry out the tests.
    e) Investigate and provide corrective actions for all the faults detected during the tests. The tests shall be resumed only after all the faults have been corrected..
    f) Submit fault reports which describe the symptom and causes of the faults and the corrective actions taken.

1) Any test shall commence only if the test procedures and design documentation associated with the test have been made available and a "Notice of No Objection" or "Notice of No Objection Subject to" have been received from The Client or the Clients' Representative.
2) Test results of the Contractor's own trial tests shall be made available to the Client or the Client's Representative on request before the tests are witnessed to indicate the readiness for tests witnessed by the Client or the Client's Representative to commence.
3) The Contractor shall carry out testing and commissioning activities by stages and in the following sequence:
    a) Factory Acceptance Testing (FAT).
    b) Site Acceptance Testing (SAT).
    c) Thirty (30) Day Test Period, before final handover.

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3.2 Factory Acceptance Tests (FAT)

1) FAT tests shall include, but not be limited to, visual, environmental, electrical and functional tests on all individual equipment and associated subsystem as well as system simulation testing before delivery of equipment to sites.
2) The FAT for the control centre (or back office) hardware and software system shall consist of a full system simulation test. This FAT shall simulate all system operational functionality. The Contractor shall develop and document a detailed FAT plan and procedures to demonstrate and test the full range of operational features of the system and its compliance with the technical requirements of the functional specification. The Contractor shall submit the system FAT plan for review, approval and sign off. The FAT plan shall include at least the following:
    a) A list of equipment and cables prerequisites for individual sub-systems required to conduct FAT.
    b) The program of all the test activities related to FAT.
    c) The locations where FAT are to be carried out.
    d) The estimated duration of test activities at each location.
    e) Submission schedule of all the FAT procedures for equipment and cables.
3) The FAT procedures shall describe all tests to be carried out to demonstrate the functional, electrical and physical performance of the equipment and interconnections under designed environmental conditions. The FAT procedures shall include the following:
    a) Detailed step-by-step procedures.
    b) The list of referenced applicable standards and methods.
    c) Test set-ups.
    d) Pass and fail criteria.
    e) Sampling plan for each test item.
    f) Test results sheets (on which test results would be recorded).
4) FAT shall include, but not be limited to the following tests:
    a) Functional testing - All functions and features of the designated equipment (hardware and software) shall be demonstrated. All interfacing shall be demonstrated, tested and verified.
    b) Burn-in testing – Proof of burn in testing for each unit shall be provided through test results of continuous operations for 48 hours.
    c) User interface demonstrations and tests.
    d) Diagnostics and redundancy demonstrations and tests.
5) All features and functionality specified in this specification shall be fully tested during FAT. The Contractor shall provide a traceability matrix which identifies the features and functions specified in this specification being verified for each test procedure. The Contractor shall simulate all interfaces and conditions to enable such tests to be carried out.
6) If any test items are to be carried out by an independent laboratory, a copy of the certificate of that laboratory by the relevant authority shall be included in the FAT procedure.
7) The Client or the Client's Representative reserves the right to witness any or all FAT. The Contractor shall provide the Client or the Client's Representative with a minimum of two (2) weeks notice when FAT are to be conducted.
8) The Contractor shall conduct FAT in accordance with the approved test plan and procedures.
9) The Contractor shall document the results of all tests (in associate test result document sheets) including any failures, corrective action to be taken and re-tests required.
10) The Contractor shall record and certify the results of all FAT and provide the Client or the Client's Representative with a final copy. The hardware shall not be delivered to the site until the all FAT has met their defined acceptance criteria and have been signed off.

3.3 Site Acceptance Testing (SAT)

1) The Site Acceptance Tests shall demonstrate and prove the operation of the system as a whole and integrated system that meets the all the technical requirements of this specifications under actual site conditions
2) The Contractor shall develop and submit a site acceptance test plan and procedures to demonstrate and test the full range of operational features of the system and its compliance with the requirements of this Specification. At a minimum, this plan shall demonstrate the same features and functions proven in the FAT. The plan and procedures shall detail the tests to be performed and the expected outcome.
3) The System Acceptance Test Plan and Procedures shall include, but not be limited to, the following:
    a) The approach to be adopted by the Contractor.
    b) The program showing the locations and dates and the estimated duration of each test activity.
    c) The detailed step by step test procedures together with pass/fail criteria;
    d) Test result sheets.
    e) List of test equipment and special tools.
    f) List of reference documents including relevant design documents, specifications, drawings, schematics and wiring diagrams, operation procedures and equipment manual.

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4) Where performance across interfaces with other parties is required to be verified during the Site Acceptance Tests, the Contractor shall include the list of the other parties and the interface test procedures.
5) The Contractor shall carry out load tests on the system to verify the designed system capacity and the system performance shall be in accordance with the requirements as set out in this specifications under full load conditions.
6) The Site Acceptance Tests shall be carried out after:
    a) Approval of the Contractor's Site Acceptance Test Plan and Procedures
    b) Successful completion of all installation tests for each subsystem or equipment;
    c) After all subsystems have been connected up together as required in this specifications and the system operates in all respects in accordance with the Technical requirements in this specifications.
7) The Contractor shall provide a minimum of two (2) weeks notice when the site acceptance test is to be conducted.
8) The Contractor shall conduct the site acceptance test in accordance with the approved test plan.
9) The Contractor shall record and certify the results of the Site Acceptance Tests and submit a copy to for review.
10) The Site Acceptance Tests are considered complete only if all the system acceptance tests have met their defined pass criteria.
11) The Site Acceptance Tests shall be successfully completed prior to the commencement of reliability demonstration testing.

3.4 Thirty (30) Day Test Period

1) The City of Cape Town (or appointed agent) shall operate any (or all) equipment, sub-system or system for a thirty (30) day period in an attempt to confirm the following aspects of the system:
    a) That the reliability and availability of equipment, sub-systems and systems meet the technical requirements of these specifications or if not specified, meet the Contractor's own declared design specifications for reliability and availability (with such specifications being included in the system design document).
    b) That the operational requirements of this Specification are achieved.
    c) That the maintenance (or service) requirements of this Specification are achieved.
2) The contractor shall evacuate all sites for the duration of the 30-day test and shall only be allowed access to the sites in instances where he/she is required to correct failures or undertake regular scheduled maintenance activities.
3) Upon the event of a failure the City of Cape Town's Agent will inform the Engineer and Contractor of the failure. In such an instance the contractor will be required to correct the failure at his/her own cost and provide a report thereon on the failure and remedial actions to the Engineer. The Engineer shall be responsible for determining whether the type and severity of failure requires the 30-day test period to be restarted. The fault report to be prepared by the contractor shall include:
    a. The date and time the fault occurs;
    b. The date and time the Contractor's staff arrive on Site;
    c. The date and time the fault is cleared and the normal operation is restored;
    d. A detailed description of the fault;
    e. The cause of the fault; and
    f. Remedial actions including equipment or components replaced (incl. serial numbers).
4) The Contractor shall start the reliability demonstration test after the remedial works identified during the site acceptance tests are cleared. The Contractor shall provide the City of Cape Town with a minimum of one (1) weeks notice when tests are to be conducted.
5) The City's agent responsible for operating the system during this time shall also keep a fault log to be submitted for review.
6) The Thirty (30) Day Test Period will be considered to have failed at any point in time for (but not limited to) the following reasons:
    a) Any fault resulting from a design omission or an omission error and shall require design modification in order to fix the fault.
    b) Any system failure that resulted in the loss of any operator-function or management-function and cannot be recovered within 12 hours.
7) If the 30-day test is halted at any point (due to a failure of the system) the Engineer shall have the right to order the test to be restarted (from day one) after the failure has been corrected.
8) If a 30-day test is halted more than once due to the failure of the same equipment the City of Cape Town reserve the right to:
    c) Instruct the Contractor to remove the equipment that does not meet the required reliability and reimburse the City of Cape Town all moneys paid for the equipment to the Contractor; or
    d) Instruct the Contractor to replace the equipment that does not meet the required reliability or make appropriate modifications to eliminate the cause of the failures, without additional cost to the City of Cape Town.

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C3.6 Project Management

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1 PROGRAMMING AND PLANNING

The Contractor is referred to Sub-Clause 8.3 in the General Conditions and the Particular Conditions.

A bar-chart type construction programme shall be submitted to the Engineer within 14 days from the Commencement Date. The Contractor shall supply an electronic version in Microsoft Project to the Engineer.

The programme shall be updated monthly during the Contract period.

The climate cannot be predicted or controlled and it is possible that the dam gates will have to be brought into operation at times of the year when not expected. The Contractor shall programme all work so that the ability to bring the gates into operation is least affected. For example, any work which will render a gate inoperable for the period shall be executed on only one gate at a time and only once this work is completed may the Contractor proceed to do the same work on a second gate.

In addition to the above, a monthly cash flow forecast shall also be submitted to the Engineer.

2 CONTRACTOR'S RESPONSIBILITY IN TERMS OF THE OHS ACT

The Contractor shall be responsible for complying with the Occupational Health and Safety Act, Act 85 of 1993, and specifically the Construction Regulations 2003 issued in terms of Section 43 of the Act (GNR 1010 of 18 July 2003).

The Contractor is referred to Part T1.2 Tender Data and the Health and Safety Specification (Annexure F) in this regard.

3 WORKS NOT TO INTERFERE

The Contractor should note that the during the 2010 Soccer World Cup event no construction may take place on the routes identified by FIFA.

4 UNAUTHORIZED PERSONS

The Contractor shall keep unauthorized persons from the Works at all times.

5 MANAGEMENT MEETINGS

5.1 Technical Meetings

Technical meetings shall be held weekly on Site and will be called by the Engineer.
The Contractor shall arrange for the Commissioning Engineer to attend these meetings.

5.2 Site Meetings

Site meetings shall be held monthly.

5.3 Health and Safety Meetings

The Contractor is referred to Clause G2.6 in Volume 2A.

6 MANAGEMENT PERSONNEL

Refer to Clause AA5 in Volume 2A.

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7 ELECTRONIC PAYMENTS

The Contractor shall provide his banking details to enable electronic payments to be made; such payments shall be at the direction of Council's Director of Procurement.

8 KEY PERSONNEL

The Contractor shall submit a schedule of key personnel, with contact particulars.

The Contractor is also referred to Clause G2.1 in Volume 2A regarding the Heath and Safety Management Structure.

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Scope of Work (Part C3.7 Detailed Specifications)		
Annex: Specifications		
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B	STANDARD SPECIFICATION FOR ELECTRICAL WORKS	C3.7-B
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F	HEALTH AND SAFETY SPECIFICATION	C3.7-F
G	BANK ISSUED FARE MEDIA AND RELATED INFRASTRUCTURE SPECIFICATION	C3.7-G
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C3.7 Detailed Specifications

Annex: Specifications

Annex specifications comprises the following Sections:

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ANNEXURE A:
DETAILED SPECIFICATIONS FOR AN EMV-BASED AUTOMATED FARE COLLECTION SYSTEM

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1. GENERAL ASPECTS

1.1. PURPOSE

These Specifications

1. serve to provide Bidders with information about the nature of the Fare System, and the specifications with which the Fare System must comply;
2. should be read in association with the Schedule of Quantities (Volume 2A Part C2), which provides further prescription; and
3. will be annexed to the Agreement to be concluded between the City and the successful Bidder (the "**Fare System Contractor**").

The Fare System Contractor will be required to warrant, in the Agreement, that the Fare System conforms to the Specifications.

1.2. DEFINITIONS

In these Specifications, the following terms bear the following meanings (provided that capitalised terms used in these Specifications and *not* defined below shall have the meanings assigned to them in main Agreement):

1. **AFC Data Structure**: A logical structure of data elements defined by the National Department of Transport as an enabler for compliance with the AFC Regulations. A formal issue of this data structure, dated 07 May 2009, has been provided in Part C3 Annexure I.
2. **AFC Regulations**: Regulations governing implementation of fare collection by electronic means, promulgated in terms of the National Land Transport Transition Act, Act 22 of 2000.
3. **Bank Issued EMV Card**: A bank issued contactless payment instrument that is
    a. issued *by a bank to its clients* and
    b. supported by banks that are members of the Payments Association of South Africa (PASA) and the relevant Payment Clearing House (PCH) and
    c. based on EMV standards, conforming to Card Association specifications for contactless payments (MasterCard PayPass or Visa payWave) and
    d. functions on the principle of pre-authorised debit and
    e. conforming to the requirements of the AFC Data Structure as issued by the National Department of Transport.
4. **City of Cape Town IRT Card:** A bank issued contactless payment instrument that is
    a. procured by the City of Cape Town and
    b. design and brand approved by the City of Cape Town and
    c. issued by the bank(s) included in the successful tender and
    d. supported by banks that are members of the Payments Association of South Africa (PASA) and the relevant Payment Clearing House (PCH) and
    e. based on EMV standards, conforming to Card Association specifications for contactless payments (MasterCard PayPass or Visa payWave) and
    f. functions on the principle of pre-authorised debit and

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g. conforming to the requirements of the AFC Data Structure as issued by the National Department of Transport.

5. **Contactless EMV Smart Card**: A collective term for the City of Cape Town IRT Card, Third Party Issued EMV Card and Bank Issued EMV Card, (as defined in this section), without regard to the issuer or the distinguishing features of each.
6. **Fare Payment Device:** A certified device that incorporates the ability to read and write to a contactless EMV Smart Card, and to integrate with the Fare Payment System in regard access and applicable fares for the IRT System
7. **Intelligent Transport Systems (ITS)**: A broad range of advanced communication technologies applied to the transportation system to make the system safe, efficient and reliable without necessarily physically altering the existing transport infrastructure.
8. **Third Party Issued EMV Card**: A bank issued contactless payment instrument that is
    a. procured and issued by an organisation *other than* the City of Cape Town and
    b. supported by banks that are members of the Payments Association of South Africa (PASA) and the relevant Payment Clearing House (PCH) and
    c. based on EMV standards, conforming to Card Association specifications for contactless payments (MasterCard PayPass or Visa payWave) and
    d. functions on the principle of pre-authorised debit and
    e. conforming to the requirements of the AFC Data Structure as issued by the National Department of Transport.
9. **Technical Platform**: The integrated set of the subsystems that together with the ongoing processes enable the Fare System. The subsystems that constitute the technical platform are: Issuance Subsystem, Top-Up Subsystem, Fare Payment Subsystem, Payment Inspection Subsystem, AFC Central Information Subsystem, Web Subsystem and Communications Subsystem, each of which is described in these Specifications.

1.3. OVERVIEW

1.3.1. Background

1. Attention is drawn to the Description of Works (Volume 2B Part C3), and to the Site Information (Volume 2B Part C4).
2. The City of Cape Town is implementing the Cape Town Integrated Rapid Transit System within the Cape Metropolitan Area, designed to transform the public transport sector through integration of high quality rail and road services. A high quality bus-based urban transit system (a concept known internationally as Bus Rapid Transit, or BRT) will form a key part of this implementation.
3. IRT will be supported by a number of technical platforms, including a control centre, traffic signal control, vehicle management, real time information, and fare collection and verification systems.
4. These Specifications set out the City's requirements for a high quality solution for fare collection for a:
    a. minimum acceptable service ahead of (and suitable for) 2010 FIFA Soccer World Cup

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b. expansion of that same service to cover the scope of IRT Phase 1A

5. The City requires proven and reliable state-of-the-art technology-based solutions for the Fare System. The Fare System must be flexible, scalable and easily expandable to facilitate interface requirements with the core ITS subsystems and expansion to support other modes of transport, similar public transport solutions in other cities and provinces and changes in fare strategies as and when required.
6. The systems and their components must be proven, reliable, efficient, open and similar in style and quality to existing systems used in high quality metro public transport systems worldwide.

1.3.2. Design Principles

1. **Compliance:** The Fare System must facilitate full compliance with all relevant legislation, regulatory requirements, and industry standards. Bidders' attention is drawn to the NDoT Draft AFC Regulations which, although they have not been promulgated as at the date of preparing these Specifications, may well shortly be promulgated in a form substantially in accordance with the gazetted draft;
2. **Cash Minimised:** All passengers must present a valid *payment media* to gain access to the IRT Stations. A similar principle will apply for the feeder buses, although a secure cash option will be required to broaden availability of service. Fare policy will be developed so as to deter the use of cash, except as a last resort, to minimise the amount of cash handling in the system.
3. **Scalable Design:** The City's IRT system will be implemented in phases to meet the growth of the system and minimise development costs and delivery times. The Fare System supporting the IRT system will therefore likewise be implemented in phases. The Fare System which is the subject of this tender must therefore be designed to be easily scalable and expandable;
4. **Minimum Disruption**: The Fare System must be implemented in such a way as to minimise the impact on all stakeholders, such as public transport operators and travellers.
5. **Flexible Fare Structure:** The Fare System must be easily customisable to implement any of the fare types described in these Specifications (regardless of which fare structures are selected for initial implementation), without extra costs or excessive lead times.
6. **Versatile:** The Fare System must be able to support the City of Cape Town IRT Card, Third Party Issued EMV Cards (including the AFC Data Structure) and Bank Issued EMV Cards. This is to ensure the system is versatile and future proof, regardless of the strategy adopted for procurement of payment media.
7. **Secure:** All components in the Fare System must incorporate robust and proven mechanisms to secure all transactions. The Fare System Contractor must implement all security measures required to guarantee that all transactions in the Fare System are properly reported, transmitted and recorded. Measures must take into account the whole life cycle of each component, with emphasis on the regular use conditions applicable in each case.
8. **Robust:** The Fare System and its components must be proven, reliable, efficient and similar in style and quality to existing systems used in high quality metro public transport systems worldwide.
9. **Confidential:** All point of sale devices and validators associated with the Fare System will have a minimum capability for checking and displaying available balances. As a general rule, such information must not be displayed at access

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gates or other public locations. Users will instead be alerted when balances are at or below a predefined threshold through an audible or visual warning.

10. **Fast:** The Fare System must minimise the interaction time between payment device and payment media, and also minimise the possibility of transaction tear.

1.3.3. Open Standards for the Fare System

1. As far as possible, and without contradiction to the forthcoming NDoT AFC Regulations, the Fare System must also comply with open standards as defined by global standards organisations.
2. An obligation remains on the Fare System Contractor, acting as a Reasonable and Prudent Operator, to determine all relevant and appropriate standards governing the solution provided.
3. A minimum set of standards has been incorporated in the specifications which form the Annexures to Volume 2B Part C3.

1.4. FARE SYSTEM REQUIREMENTS

1.4.1. Design and Implementation of the Fare System

1. The National Department of Transport has gazetted draft regulations concerning Automatic Fare Collection in South Africa ("AFC Regulations"), and made the AFC Data Structure publically available on 07 May 2009. The City of Cape Town intends for the IRT Fare System to be fully aligned with these regulations and to utilise the AFC Data Structure. These technical specifications have been prepared on the reasonable assumption that the regulations ultimately promulgated will be materially equivalent to the gazetted draft.
2. In terms of the AFC Regulations, this IRT Fare System does not constitute a 'legacy system', and shall therefore be designed primarily around EMV Fare Media preloaded with the AFC Data Structure.
3. The Technical Platform for the Fare System consists of a set of interconnected subsystems dispersed geographically across Cape Town, the Stations, the Vehicles, the Control Centre and possibly other offices of the City of Cape Town. The subsystems that make the technical platform are:
    a. Issuance Subsystem
    b. Top-up Subsystem
    c. Fare Payment Subsystem
    d. Payment Inspection Subsystem
    e. AFC Central Information Subsystem
    f. Web Subsystem
    g. Communications Subsystem
4. It is envisaged that the Fare System Contractor will provide the basic functionality of the issuance subsystem for contactless EMV Smart Cards, through an associated Bank or third party System Operator, in accordance with the banking standards set out in Part C3 Annexure G. The Issuance Subsystem within the Fare System refers to this functionality plus the additional requirement for this subsystem to deliver the transit functionality as a wrapping layer to the core.

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5. The Fare System must also be able to interface effectively with the fleet management system, which is to be procured separately by the City of Cape Town as part of the ITS Programme. The fleet management system is known as the Advanced Public Transportation System (APTS), and equipment will be installed by a third party contractor on the entire IRT Fleet, including trunk buses and feeder buses. Integration will take place primarily in the back office environment, and reference is made to Section 6.8 below.
6. The system design must be scalable for future expansion over a number of years, so the first phase of implementation (that is, 2010 FIFA Soccer World Cup, and the IRT Phase 1A) must not be the limit of the system. The expansion path must be cost effective, without undue dependency on bespoke software and proprietary equipment.

1.4.2. Payment Media in the Fare System

1. This section provides minimum standards for the fare media to be accepted by the Fare System. As a basic design principle, the Fare System is limited to Contactless EMV Cards hosting the NDOT AFC Data Structure, in line with the forthcoming regulations. Attention is drawn to the NDoT AFC Data Structure provided in Part C Annexure I.
2. The Fare System Contractor shall develop, test and ultimately supply a Technical Platform that allows all functionalities described in these Specifications, and supports all of the following contactless EMV Cards:
    a. the City of Cape Town IRT Card (supplied through this contract)
        i. Unregistered cards will have a standard print, to be approved by the City
        ii. Registered cards will have a modified print, for example a photograph or other distinctive marking, to be approved by the City.
    b. Third Party Issued Contactless EMV Card (supplied by third party system operators, independently of the City)
    c. Bank Issued Contactless EMV Card (supplied by an issuing bank directly to their existing customers)
3. The City of Cape Town IRT Card shall be
    a. compliant with current EMV contactless standards, as presented on the EMVCo Website (http://www.emvco.com/), including ISO14443-A;
    b. conformable to the dimensions set out in ID-1 in ISO 7810, with appropriate substrate;
    c. based on the principle of prepaid stored value and operating on the principle of pre-authorised debit;
    d. adhere to specific standards for that payment media as defined by bank members of the Payments Association of South Africa (PASA) and the relevant Payment Clearing House (PCH); and
    e. host the AFC Data Structure defined by the National Department of Transport.
4. For the purposes of testing the system, the Fare System Contractor must
    a. issue specimen examples (clearly marked as such) of the proposed City of Cape Town IRT Card

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b. provide a framework for testing specimen cards issued by banks other than the issuing bank associated with the Fare System Contractor

1.4.3. Fare Regime

1. The City of Cape Town retains the prerogative for setting and implementing a fare structure and fare products appropriate to the needs of IRT Passengers. However, the Fare System must (as a minimum) be able to accommodate the following:

    a. **Pay as you go fares:**

        i. To use these fare products, passengers must load electronic value to the card from a preauthorised debit source account, subject to the Top-Up Limits and Balance Limits defined by the issuing bank.

        ii. The value of the fare will be deducted at turnstiles in the IRT Stations and also at validators onboard the Feeder Vehicles, following rules for **pay-as-you-go** fares, which will be provided to the Fare System Contractor by the City. As a general rule, pay-as-you-go fares will be calculated by travel distance, and therefore entry *and* exit validation are required to determine the value to deduct.

        iii. Pay-as-you-go fare rules will be a set of mathematic functions that yield the fare value for each journey. As an indication, it is anticipated that the formula will combine the following parameters:

            - User type (i.e. full fare customer, concessionary fare) as defined by the City from time to time)
            - Route number and boarding and/or alighting locations for journeys that include feeder services.
            - Boarding and/or alighting stations, for journeys that include trunk stations.
            - Time of the day and day of week of entry validation(s)
            - Time of day and day of week of exit validation(s)
            - Time of day and day of week for previous entry and exit validation(s).

        iv. With pay-as-you-go fares, value will be deducted at boarding and/or exit validations, according to the rules set by the City from time to time.

    b. **Travel Pass**: These transit products should be hosted using an appropriate marker on the card, within the secure area of the NDoT AFC Data Structure. The Fare System must then be able to read and match this information with additional information regarding that product, and provide access to the IRT System as appropriate. Products can be purchased through the Top-Up Subsystem within the Station, and must be validated by the Fare Payment Subsystem before access. The following period-pass products are envisaged:

        i. Grants unlimited travel rights within all IRT services, for as long as the pass has not expired. The Fare System Contractor must provide passes with different validity, which shall be configurable and defined by the City from time to time, but must be capable of accommodating the following:

            - **Passes by days**: 1, 2, 3, 4, 5 and 7 days

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- **Passes by months**: 1, 2, 3 and 6 months
- **Passes by year**: 1 year pass

ii. Passes for 7 days or more must be personalised, including a photograph of the authorised user.

iii. The City will set a limit, which must be configurable, on the number of boarding transactions that can be done each day with passes valid for a day or longer. After that number of transactions is reached, the card will not allow further travel until the next day. Information regarding the number of boarding transactions is recorded in the unsecure area of the NDoT AFC Data Structure. The Fare System must be able to compute a one-time valid Message Authentication Code (MAC), to ensure the integrity of the unsecure area.

iv. The City may also choose to provide specific entitlements for travel to certain segments of the population. These may take the form of a fare discount, initiated by first reading the relevant concession indicator on the card and then applying a reduced fare. Where relevant, the business rules shall be defined by the City and implemented by the Fare System Contractor. These rules shall be configurable and can be revised by the City as necessary at no additional cost to the City during the life of the Agreement. All such passes shall carry a photograph of the owner.

2. The City will provide to the Fare System Contractor the business and fare rules for calculating the initial pay-as-you-go and travel pass fare products. During the contracted period of service, the Fare System Contractor must implement, at no additional cost to the City, any changes required to the fare products.

1.4.4. Passenger Fees

1. Operating costs must be minimised in order to remain within projected fare revenues, as fares must remain competitive and no operational subsidies will be made available by the City.
2. The technical platform must include bespoke software which allows for differential fees to be charged by location, giving the option to balance demand between On Station and Off Station activity.
3. Fee levels will be determined in a competitive environment, recognising that the market will contain different brands of contactless EMV Cards, and not just the City of Cape Town IRT Card.
4. Fees may change from time to time, and any such changes are to be implemented by the Fare System Contractor at no additional cost to the City, as part of the regular maintenance and parameter settings of the bespoke software.
5. The Fare System Contractor must provide a wrapping layer around the ‘standard’ activation and top-up subsystem, to allow exchange of information regarding levels of activity and implementation of any additional fees required by the City (for demand management purposes).

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1.5. TECHNICAL REQUIREMENTS APPLICABLE TO ALL SUBSYSTEMS

1.5.1. Software Requirements

1. All software developed for the Fare System must be compliant with the ICT Specifications provided in Part C3 Annexure D, with particular reference to Section PS8 'Software'.
2. Where possible, applications shall be modular commercial off-the-shelf, and simple to support.
3. Applications shall have been developed utilising non-proprietary open standards development tools. They shall be dynamic, transaction based and highly and easily customisable to deliver specific functionality for IRT requirements.
4. Modifications and enhancement required shall be developed by the Fare System Contractor using approved industry standard software development processes and procedures.
5. Applications applicable to this Fare System should be capable of running on multiple platforms, with the most current version of Microsoft Windows Server Software being the minimum requirement.
6. For bespoke developments, applications shall be multi-layer, typically a presentation layer (client presentation and access), an application layer (business rules and processes, business objects, kernel), and a database and reporting engine.
7. Applications shall have industry standard open application protocol interfaces (API) to facilitate integration with other ITS systems.
8. Administrator functionality shall be available to facilitate user and administrator regimes, API and customisation (for all layers).
9. Applications shall maintain a detailed transaction log that can be presented and reported at any point in time related to any effected data attribute(s).
10. Work stations (or user interfaces) shall have graphical user friendly interfaces to all applications, and functionality of a thin client.
11. Applications shall have a comprehensive, user friendly and customisable reporting capability, to cater to both ongoing operational needs of the Fare System and ad-hoc reporting requirements which may arise from time to time.
12. Applications shall have comprehensive reconciliation functionality in terms of all relational data attributes for presentation and reporting.
13. Applications shall have customisable data securitisation and promulgation regime.
14. Application databases shall facilitate archiving and real time transaction and data mirroring to failover.
15. Configuration of all bespoke developments must be managed using an industry standard product. As a minimum, this must provide configuration identification (including version control of software and revision control over associated product documentation), change control, release control and status accounting.
16. All user and system administrator interfaces shall be web-enabled.
17. All applications (bespoke and standard) shall be supported by administration functionality to control user access and rights.

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18. Data shall be standardised to assist interoperability across Fare System, the APTS, other modes, operators and transit networks. Data from databases shall be exchangeable and exportable (e.g. XML).

1.5.2. Hardware Requirements

1.5.2.1. General Requirements

1. All hardware provided as part of this tender must be compliant with the ICT Specifications provided in Part C3 Annexure D, and additionally the EMV Specifications provided in Part C3 Annexure G.
2. All equipment shall be certified by recognised certification authorities, including those required by Law.
3. All critical equipment shall be configured for redundancy, to ensure high availability of the system. Availability requirements are set out in the Draft Service Level Agreement, provided in Part C3 Annexure H.
4. All equipment must be robust, industrial type, proven and fit for purpose.
5. Configuration of all bespoke developments must be managed using an industry standard product. As a minimum, this must provide configuration identification (including version control of software and revision control over associated product documentation), change control, release control and status accounting.

1.5.2.2. Requirements for electrical equipment

1. Attention is drawn to the Electrical Specifications provided in Part C3 Annexure B.
2. All enclosures shall contain an easily accessible and labelled main circuit breaker that will isolate the equipment when tripped. Breakers shall clearly indicate status, i.e. on, off and tripped.
3. All enclosures, chassis, assemblies, panels, switch and terminal boxes, and exposed metal equipment shall have an earth stud or earth bar. The latter shall be bonded to the local earth node
4. Conductors carrying 50 volts or more shall not be bundled with lower voltage conductors.
5. Protection shall be provided against radio frequency and electromagnetic interference emission sources, including internal conductive or inductive emissions.
6. Each device must work in its operational environment without being affected by harmful interferences, and will incorporate protection as required in order to avoid radio-frequency interference, and internal conductive or inductive emissions.
7. Equipment must not be affected by electromagnetic fields generated by power transmission lines, by local distribution or by the magnetic effects presented during the operation of the Fare System or any other components of IRT.
8. The Fare System Contractor must certify (or provide independent verification) that all hardware provided is electromagnetically compatible.
9. The Fare System Contractor must secure all governing certifications and shall be responsible for all cost associated. A Certificate of Compliance shall be required for each installation.

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1.5.2.3. Environmental Requirements

1. The following environmental specification ranges are required by the City as a minimum
    a. Operating Temperature: -5℃ to +50℃
    b. Storage temperature: -20℃ to +70℃
    c. Humidity: 0-90% relative humidity (non-condensing)
    d. Shock: 30g for milliseconds and up to 5g sustained
    e. Operating vibration: 1.5g RMS, 5 -150 Hz
    f. Solid object and moisture protection indoors inside plant rooms: IP 4X
    g. Solid object and moisture protection outdoors: IP 54.
2. Water and solvents: Equipment must be resilient to the effects of water spray on equipment as result of cleaning activities, industrial solvents, rain, mud, hail, snow and slush, all of which may contain salts that may come into contact with equipment.
3. The Fare System Contractor shall provide overvoltage protection for all equipment installed under this contract. The City will not entertain claims regarding damage due to overvoltage.

1.5.3. Functional Requirements

1. Payment media applications shall provide interface, control, data exchange transmission and data processing functionality in support of all the Fare System components, including:
    a. Contactless EMV Smart Card
    b. On-board entry validation devices for feeder buses.
    c. Station entry and exit fare payment devices.
    d. EMV Smart Card Vending Machines (CVM).
    e. EMV Smart Card Office Machines (COM).
    f. EMV Smart Card Portable Card Validators (PCV).
    g. CoCT IRT EMV Smart Card ordering and payment via a web portal.
    h. Transit availability information for passengers via the web
    i. Centralised Fare System applications that shall provide for:
        i. Transit life cycle management (including personalisation).
        ii. Fare transaction validation and management.
        iii. Bank card payment transaction collation, logging and communication to the acquiring bank and the National Payment System for financial clearance of bank card payment transactions.
        iv. Data warehousing and reporting.
        v. System management interface(s).
        vi. Back office interfaces to the relevant other ITS systems.
2. The AFC System shall provide functionality for finance and revenue management, operations management and maintenance management. Functionality shall include:

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a. Fare regimes (multi-dimensional table array) development, setup, roll out and management.

b. Cash management, transaction accounting and reconciliation of all products.

c. Reconciliation, determination of payment due and payment to contracted third party services providers (for example an additional bus operator).

d. Real time communications to command and control deport and station equipment.

e. Diagnostics and monitoring of all system hardware and software components and retention of an overall system operational log for all items of equipment record of activity and operation over time.

f. Data collation, storage and reporting (extensive). Reporting shall facilitate multi-dimensional reporting against any database primary key and related data attributes.

g. Financial accounting and reporting.

3. In addition to the sale of the City of Cape Town IRT Card to passengers, the system shall be able to issue and manage (under strictly controlled conditions) contactless EMV Smartcards for purposes such as:

    a. Employee pass-issued to operator employees for identification purpose, station access.

    b. Temporary duty pass-issued to contractors, consultants and visitors.

    c. Test pass-issued under maintenance mode to permit setup and testing of CVM, COM, PCV and fare payment devices.

4. For security and system integrity, the diagnostics and monitoring functions shall monitor and record the following as a minimum:

    a. status of card and cash inventories, including stock levels,

    b. processing components COM and CVM,

    c. power and battery status,

    d. general faults, jams, communications malfunction, tampering and unauthorised pass work attempts (including alarms).

5. All failures shall be logged and reported in accordance with a criticality rating regime that will be set up, to System Administration via sms or e-mail and at the next log into system.

6. The online control of COM, CVM and fare payment devices shall include (but not necessary limited to):

    a. Switch individual or group of equipment in/out of service.

    b. Switch mode of operations.

    c. Switch all Station gate(s) or selected gates emergency open mode.

    d. Switch all Station gate(s) or selected gates close mode.

    e. Control gate(s) to limit access to certain card and/or fare types as a means to prevent station overcrowding.

    f. Switch/swap entry/exit direction of gates, where relevant.

    g. Station ‘shut down’ or ‘start up’ (all station equipment).

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7. Data backup shall be provided to be able to restore a rolling full year archive.
8. System access control shall be based on establishment of user groups, users and roles under control of configurable systems administration tools. A minimum of three level of access shall be available; administrator, user and view rights only.
9. System alarms shall include, but not be limited to:
    a. Erroneous data detection (including imports)
    b. Security detection (unauthorised access attempts)
    c. System or system device fault detection.
10. All alarms shall be logged and stored in the database along with history of corrective action.
11. The system shall be able to authenticate using Active Directory and/or LDAP.

1.5.4. Integration Requirements

1. The Fare System Contractor for the Fare System shall be responsible for the end-to-end integration and operation of all relevant subsystems and devices of the Fare System. The Fare System Contractor shall guarantee communication (within scope of responsibility) and functional integration of the payment device. For this purpose, the Fare System Contractor makes the following commitments:
    a. The Fare System Contractor undertakes to supply all technical and functional information required with regard to the minimum characteristics which this equipment - and the communications systems related to it - must have so that by complying with those technical conditions, there will be guaranteed integration of that equipment into the Fare System.
    b. The Fare System Contractor shall be responsible for the acceptance of bank issued EMV cards for fare payment at fare payment devices. Fare payment devices are to be compliant with any requirements stipulated by the banking and payment cards industry, regulatory authorities, or as required by compliance regimes relevant to the jurisdiction such as codes of practice. The Fare System Contractor shall be responsible for gaining any such approval as mandated by these parties, to ensure the fare payment devices achieve and retain compliance to operate in the local jurisdiction. The Fare System Contractor shall be responsible for any project management or testing regimes required to achieve any such approval.
    c. The Fare System Contractor will ensure functional integration between the Fare Payment Subsystem and Portable Validators, for business continuity in the event of a failure within the Fare Payment Subsystem.
    d. The Fare System Contractor will provide detail of the formats, standards, and protocols for communication for the collection equipment on board, and its system of communication with the Fare System.
    e. The fare payment equipment and its interface for integration will be developed with open standard technology, thus allowing the City the option to use different suppliers, should the City deem such action necessary over the lifecycle of the fare payment system.
    f. The Fare System Contractor will determine the method, technology and procedures most appropriate for the integration of the equipment with the Fare System. The City reserves the right to approve or modify this procedure.

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g. The Fare System Contractor undertakes to supply fare payment devices and related fare payment equipment required to integrate into the Fare System, if so requested by the City at any time during the validity of this Agreement, and to assume responsibility for its installation and integration with the Fare System and maintenance.

h. In the event that the City enters into an agreement with any third party for the provision or integration of equipment or systems into the Fare System environment, the Fare System Contractor shall be obligated to work collaboratively with these parties to integrate the designated equipment or systems into the Fare System.

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2. ISSUANCE SUBSYSTEM

2.1. FUNCTIONAL REQUIREMENTS

1. It is envisaged that the Fare System Contractor will provide the basic functionality of the issuance subsystem for contactless EMV Smart Cards, through an associated bank and/or third party system operator, in accordance Annexure G in Part C3, “Bank Issued Fare Media”.
2. All such systems must comply with the PASA Interoperability Policy and integrate with the Debit/ Credit Card PCH via the sponsoring PASA member.
3. The purpose of this section of the technical specification is to outline the additional requirements for this subsystem to deliver the transit functionality as a wrapping layer to the core.
4. This subsystem must have the capability to perform three core functions:
    a. activate and issue a City of Cape Town IRT Card, writing appropriate information to the AFC Data Structure;
    b. with reference to Section 1.5.3, activate issue and manage additional cards for operational purposes;
    c. maintain and manage a hotlist of cards no longer accepted in the system due to suspected fraudulent activity (in respect of transit data and use of products only, since issuing banks will already have processes in place to monitor suspicious financial transactions).
5. The issuance subsystem must be able to send a transaction record to the Central Information Subsystem for each card activated.
6. The issuance subsystem must have enough capacity to satisfy the demand for payment media at any time.

2.2. DESIGN SPECIFICATIONS

1. Security aspects of the issuance subsystem must be fully compliant with Part C3 Annexure G.
2. The Fare System Contractor will prepare a design that guarantees the security of the Fare System. Design of the issuance subsystem will be an integral part of an overall security design that guarantees a secure payment system.
3. The security design must include the potential to implement a collection of public knowledge and secret keys (that is, a mechanism of shared secret keys, where the City and the Fare System Contractor will each provide a fragment of the keys).
4. In the event that this is required, the Issuance Subsystem must then accommodate a set of Secure Access Modules (SAM) for the storage of these keys in the terminals where cards are issued.
5. The Fare System must include sufficient quantities of equipment in relation to the issuance subsystem to satisfy the levels of service stipulated in the Agreement.

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3. CARD DISTRIBUTION AND VALUE LOAD SUBSYSTEM

3.1. OVERVIEW OF SUBSYSTEM

1. The card distribution and value loading subsystem can be classified by primary types of equipment:
    a. Attended Points of Sale (POS) for:
        i. Transit product sales and loading
        ii. Loading of pre-authorised electronic value
    b. Unattended vending machines
        i. Card sale and distribution
2. The subsystem can also be classified by location, as:
    a. On-Station card distribution and value loading subsystem, comprising card vending machines and value loading terminals, and
    b. Off-Station card distribution and value loading terminals at appointed retail outlets.
3. Other third party point of sale terminal devices will be installed at various locations independent of those supplied through this contract. These devices provide another option for loading of value on contactless EMV Smart Cards which may subsequently be used on the IRT.

3.2. ATTENDED POS – FUNCTIONAL REQUIREMENTS

1. All attended POS supplied in this contract will comply with the minimum functional specifications set out in this section. In addition, attention is drawn to Annexure G in Part C3, “Bank Issued Fare Media”.
    a. Activate a City of Cape Town IRT Card
    b. Loading of value and/or transit products to the City of Cape Town IRT Card.
    c. Store a transaction record for all passenger transactions (activation and top up), including the following as minimum:
        i. date and time
        ii. unique ID of attended POS
        iii. unique consecutive ID of that transaction in the system.
        iv. transaction type identifier (value loading, sell travel pass, etc)
        v. value of transaction (or error)
        vi. unique ID of payment media in the transaction
        vii. unique ID of master card used to activate the attended POS
    d. Store a transaction record for all operator transactions, each transaction record must include at least the following:
        i. date and time;
        ii. unique ID of attended POS;
        iii. transaction type and ID;
        iv. result of the transaction (or error); and

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v. unique ID of the master card used to activate to POS.

e. Send all transaction records to AFC Central Information Subsystem, compliant with the following:

i. all transmissions must be confirmed by the receiver.

ii. communication must include standard algorithms to check possible errors in data transmission. If errors are detected, the erroneous information must not be recorded in the Fare System CIS

iii. automatic re-transmission, including intelligent switching from primary communication channel to secondary communication channel.

f. All activation and top-up transactions shall be completed on-line and in real time.

g. Accept and automatically process payments for IRT cards and value loads by utilising other bank issued payment products and cards.

2. The Fare System Contractor shall specify and implement payment card processing in such a way as to minimise the revenue collection risk to the City. All associated compliance requirements to facilitate such payment acceptance must be met throughout the life of the Agreement.

3. Incorporate communications that are fit for purpose, with sufficient bandwidth and speed of transmission required to address the functional and technical requirements for transmitting transaction data to the Fare System and the appropriate Acquiring Bank.

4. Send all transaction records of value loads to contactless EMV Smart Cards to relevant Issuing Banks, in compliance with processes prescribed by the Issuing Bank, card associations and PASA.

5. Send to the City's Acquiring Bank all transaction records from sales of travel passes and related products. These transaction records must comply with all applicable banking standards and regulations.

6. Update automatically the fare regime.

7. Validate the authenticity of the payment media and ensure it has not been tampered with (both secure and unsecure aspects).

8. Have the ability to write information about travel product to the appropriate section of the NDoT AFC Data Structure

9. Check and display the balance and/or the travel passes available in the different payment media

10. Display to users on a screen variable instructions for outcomes of transactions.

11. On demand from users, print transaction receipts summarising the outcome of the transactions.

12. All attended and unattended POS functionality shall be configurable, allowing the City the flexibility to enable or disable functions as required for the operating environment or any fare / business rules which may be implemented from time to time.

13. Accept and automatically process payments with credit and debit cards, for payment of the loading of pre-authorised value. The Fare System Contractor must ensure that all associated compliance requirements to facilitate such payment acceptance are met throughout the life of the Agreement.

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14. COM installed in the kiosks shall include functionality to enable card personalisation, to comply with the personalisation rules as defined by the City.

3.3. ATTENDED POS – TECHNICAL REQUIREMENTS

1. At a minimum, the platform for attended POS systems shall include the following components:
    a. User display
    b. Pinpad keyboard,
    c. Contactless writer / reader
    d. High speed, durable printer
    e. Communication ports
    f. Secure Access Modules (in the event that the City requires a SAM for the unsecure areas)
    g. Internal power supply for component power supply and battery power in case of outage.
    h. A ventilation system to ensure proper temperature operation.
    i. Interfaces to connect to power supply and LAN (TCP/IP)
2. The Fare System Contractor is responsible for the acceptance of debit and credit cards as payment for sale of transit products and/or the loading of value transactions on attended POS. Such components of the POS must be compliant with any requirements stipulated by the payment cards industry, PASA and other regulatory authorities, or as required by compliance regimes relevant to the jurisdiction, such as codes of practice.
3. The Fare System Contractor shall be responsible for gaining any such approval as mandated by these parties, to ensure the POS devices achieve and retain compliance to operate in the local jurisdiction.
4. The Fare System Contractor is responsible for any project management or testing regimes required to achieve any such approval.

3.4. UNATTENDED POS – FUNCTIONAL REQUIREMENTS

1. All unattended POS supplied in this contract will comply with the minimum functional specifications set out in this section. In addition, attention is drawn to Annexure G in Part C3, “Bank Issued Fare Media”.
2. Tender responses must include relevant proposals on the employment of processes to meet the requirements of the Financial Intelligence Centre.
3. All value load transactions shall be completed on-line, in real time, in compliance with relevant banking and payment industry standards.
4. The unattended POS must store a transaction record for all transactions, and include at least the following:
    a. date and time
    b. unique ID of unattended POS
    c. unique consecutive ID of that transaction in the system

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d. transaction type identifier (i.e. value loading, sell travel pass, etc)

e. value of transaction (or error)

f. unique ID of payment media in the transaction

5. The unattended POS must send all transaction records to the AFC Central Information Subsystem; in compliance with the following:

    a. all transmissions must be confirmed by the receiver;

    b. communication must include standard algorithms to check possible errors in data transmission. If errors are detected, the erroneous information must not be recorded in the Fare System CIS;

    c. automatic re-transmission, including intelligent switching from primary communication channel to secondary communication channel.

6. All value load transactions shall be completed on-line and in real time.

7. Specify and implement payment card processing in such a way as to minimise the revenue collection risk to the City. All associated compliance requirements to facilitate such payment acceptance must be met throughout the life of the Agreement.

8. Incorporate communications that are fit for purpose, with sufficient bandwidth and speed of transmission required to address the functional and technical requirements of unattended POS for transmitting transaction data to the Fare System and the appropriate Issuing and Acquiring Bank.

9. Send all transaction records of value loads on contactless EMV Smart Cards to relevant Issuing Banks, in compliance with processes prescribed by the Issuing Bank, card associations and PASA requirements.

10. Send to the City's Acquiring Bank all transaction records from sales of travel passes and related products. These transaction records must comply with all applicable banking standards and regulations.

11. Update automatically the fare regime.

12. Validate the authenticity of the payment media and ensure it has not been tampered with (both secure and unsecure aspects).

13. Have the ability to write information about travel product to the appropriate section of the NDoT AFC Data Structure

14. Check and display the balance and/or the travel passes available in the different payment media.

15. Display to users on a screen variable instructions for outcomes of transactions.

16. On demand from users, print transaction receipts summarising the outcome of the transactions.

17. All attended and unattended POS functionality shall be configurable, allowing the City the flexibility to enable or disable functions as required for the operating environment or any fare / business rules which may be implemented from time to time.

18. Accept and automatically process payments with credit and debit cards, for payment of the loading of pre-authorised value. The Fare System Contractor must ensure that all associated compliance requirements to facilitate such payment acceptance are met throughout the life of the Agreement.

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19. Offer features and functions to assist disabled passengers with using the device, for example audio instructions, and controls mounted at a suitable height for wheelchair users.
20. The visual interface must comply with the following:
    a. Show all interaction information/instructions on a display.
    b. Receive interaction from the payment media holder via a traditional alphanumeric keyboard.
    c. Be simple and intuitive to use and offer logical menus to users with associated function keys.
    d. Include a language option key and a cancellation of current operation key.
    e. Recognise successful key strokes through emitting a sound.

3.5. UNATTENDED POS – TECHNICAL REQUIREMENTS

1. At a minimum, the platform of the unattended POS system must include the following components
    a. User display
    b. Pinpad keyboard
    c. Contactless writer / reader
    d. High speed, durable printer
    e. Communication ports
    f. Secure Access Modules (in the event that the City requires a SAM for the unsecure areas)
    g. Internal power supply for component power supply and battery power in case of outage.
    h. Internal storage memory of at least 100GB, readily expandable as needed.
    i. A ventilation system to ensure proper temperature operation.
    j. Interfaces to connect to power supply and LAN (TCP/IP)
    k. Unattended POS must comfortably fit within 2000x1100x700 mm (height x width x depth), including space for cabling and adequate ventilation. Dimensions correspond to the space that has been provided for at IRT stations, and represent a maximum rather than a target size.
    l. Unattended POS shall be designed to form part of an integrated ergonomically designed passenger servicing environment.
    m. All interaction devices shall be fit for purpose, international best practice anti-vandalism secured, of fit for purpose size and brightness and ergonomically positioned for optimum view angle. Where physical function keys are employed, these shall be metal and screens shall be protected by glare-free polycarbonate (or similar) sheeting.
    n. The Fare System Contractor shall provision all required accessories as part of the unattended POS.
    o. An internal (enclosed) keyboard and screen shall facilitate maintenance and inspection modes.

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p. Unattended POS shall include security and audit trails that preclude fraud or theft by staff servicing or maintaining the device.

2. It is envisaged that the contactless EMV Smart Cards will be inserted first into an appropriate card slot for processing. Where value (for top-up or product purchase) is to be provided using a credit or debit card, it is preferable for this second card to be inserted in the same slot.
3. The Fare System Contractor is responsible for the acceptance of debit and credit cards as payment for sale and/or value load transactions on attended POS. Such components of the POS must be compliant with any requirements stipulated by the payment cards industry, PASA and other regulatory authorities, or as required by compliance regimes relevant to the jurisdiction such as codes of practice.
4. The Fare System Contractor shall be responsible for gaining any such approval as mandated by these parties, to ensure the POS devices achieve and retain compliance to operate in the local jurisdiction.
5. The Fare System Contractor is responsible for any project management or testing regimes required to achieve any such approval.

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4. FARE PAYMENT SUBSYSTEM

4.1. GENERAL INFORMATION

1. The Fare System Contractor shall supply the following components as an integral part of the Technical Platform
    a. Access to IRT Stations (Gates)
        i. **Two Way Standard**: this gate permits validation of a payment media in both directions, in which entry and exit may be remotely selected from the central information subsystem, or manually by a person at that station.
        ii. **Two Way Wide Access**: that (in addition to the basic functionalities of standard two way access gates) provides physical access for wheelchairs and pushchairs.
    b. Access to Feeder Vehicles (Validator)
        i. **Standalone Validator**: A standalone validator mounted near the driver, which controls access through deduction of appropriate fare.
        ii. **Standalone Cash Box**: A secure cash collection device for occasional use by passengers, in the event that they are not able to obtain or top-up a contactless EMV Smart Card for this first or last leg of their journey.

4.2. FARE PAYMENT AT IRT STATIONS

4.2.1. Design Requirements for Access Gates

1. The Fare System Contractor will provide access control gates for the IRT Stations, suitable for the following purpose:
    a. to differentiate between paid areas at IRT Stations from unpaid areas;
    b. to authorise the entry or exit of passengers from the IRT System, and validate collection of the fare, charged to the means of payment;
    c. to read and write to contactless EMV Smart Cards for enabling passenger access;
    d. to record entry and exit transactions of passengers to and from the paid area of Stations;
    e. to send transaction data to the AFC Central Information Subsystem, and also to the City's Acquiring Bank.
2. The design of the access control gates must ensure reliability, comfort, safety, durability, and high-speed operation for the passenger flow. The design must include the following minimum components:
    a. a physical mechanism to control entry and exit of authorised passengers;
    b. a Fare Payment Device to read all contactless EMV Smart Cards;
    c. ability to record and store the number of passengers using the IRT System, and transmit the information to the Fare System;

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d. pictograms of approach, guidance, passenger information screens, and audio indicators, reporting the validity of the amount of value deducted from the payment media;

e. audible alerts aimed as Station Personnel, to facilitate the control of fare evasion or unauthorised access by passengers (such measures are to address a broad range of fare evasion scenarios and shall reflect industry best practices);

f. internal battery backup, to ensure no loss of information, and to guarantee 'return of gate' to prescribed position in the even of power loss;

g. computing requirements to transact, process, display, store and report payment media transactions securely;

h. local data storage capacity sufficient to keep fare tables and information of blacklisted and expired fare payment media, and at least 48 hrs of operational data. (no data shall be lost during any power outage);

i. incorporate at least a two line 16 character LCD type display to facilitate transactions outcome interface to card users. The display shall be a dynamic programmable TFT-LCD type or acceptable equivalent capable of displaying information in English as well as colour graphics and special characters;

j. the unit should ideally consist of angel wing bi-parting reinforced Glass or Perspex leaves, which are fit for purpose to this environment;

k. the units must have a minimum of 24 optical sensors:

   i. each sensor shall use pulse beams to allow for perfect operation in direct sunlight and as to not be foiled by a flashlight

   ii. the sensor shall be deployed in a matrix configuration such that each optical receiver shall detect the beams from several optical transmitters;

   iii. the optical detection matrix shall offer at least 96 detection beams;

l. the Fare System Contractor must provide all electrical and data transmission installations required, and the City will provide power conduits in equipment room adjacent to the point of sales office;

m. The City reserves the right to take part in the design and final definition of the equipment, in order to guarantee compatibility and aesthetics in accordance with the requirements of the system's corporate image;

n. the Fare System must allow authorised personnel of the IRT System to gain access to restricted areas for service or maintenance purposes, but not to gain access to ride the IRT System as passengers at no cost;

o. the Fare System Contractor must provide passenger counters as part of the total fare management system.

3. The access control gates for the Fare System will be fit for purpose for a transit environment. As a minimum, the gates shall take account of the following design characteristics:

   a. similar in design and aesthetic appearance, irrespective of where used;

   b. ergonomically design, free of rough surfaces, sharp angles, or points, or any element which may cause damage to users;

   c. edges and corners will be rounded to a bending radio of at least 15mm;

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d. designed for heavy traffic for the mass access of passengers, resisting operation, dust, vibration and environmental operating conditions defined in these Specifications;

e. equipment rigidity guaranteed by the use of a City structure, and an appropriate system for anchoring elements or modules other than to a City structure (the structure should be anchored to the tiled concrete floor at a minimum of four points);

f. the housing shall be impermeable and have sufficient features to protect its electronics, and all components inside the gate, appropriately;

g. the housing will also have a modular design which will allow the rapid replacement of a module in the event of damage, the effects of force, etc, without it being necessary to replace the entire unit (allowance should be made for easy-access doors for repairs, replacement, or maintenance of the elements in the gate);

h. hinges and locks on doors must be disguised or hidden, and all doors must be able to open easily with a single master key;

i. a piece of furniture must be designed to contain the reader and validation complete equipment for the 'wide access gate', following specifications of materials, finish, safety and information in this document;

j. incorporate high-speed pass-gate operation with integrated tailgate detection, which is compatible across all access control systems;

k. the Fare System Contractor shall analyse human factors in relation to the location of readers, such that these promote fast passenger flow (at least 40 passengers a minute);

l. unit shall be robust for the operating environment, with due consideration of

    i. operating temperature range

    ii. storage temperature range

    iii. humidity range without compensation

    iv. low temperature for operation and start up

    v. high temperature for operation

    vi. protection index (dust and liquids)

4.2.2. Functional Characteristics of the Access Control Gates

1. Access control gates must have the following functional characteristics as a minimum:

    a. access gates will allow passage in response to a validation of payment;

    b. gates shall have a silent operation, and a shock-absorbing mechanism for strong blows, which will allow the wings to return systematically to normal operating position;

    c. payment media shall be securely validated both at entries and exits and access gates must perform the fare payment deductions from the cards, (for both product validation and payment deduction);

    d. display a green/red light and similarly display a readable relevant message and audible beeper to the passenger informing entry pass or not;

    e. wide access doors will open only after a successful validation of payment media, followed by a validation of an inspector's card.

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2. Payment media validation and fare payment shall take place offline.
3. Validators must be able to access and store information about the fare regime, including all automatic updates issued by the Fare System.
4. Access gates must have an anti-collision mechanism enabled for all payment media types required.
5. Access gates at stations shall not permit passenger pass through under any of the following conditions:
    a. Attempted use of invalid payment media (including variety of contactless smart cards which are not payment products issued by PASA member banks);
    b. Attempted use of a valid contactless EMV Smart Card but with insufficient value (at least minimum fare) or absence of valid product (such as a period pass);
    c. Attempted use outside IRT operational time (although in practice it is likely that the station will be physically closed at this point, the system must still be able to differentiate time);
    d. Attempted use for exit of a contactless EMV Smart Card that is not recognised to be 'in transit' (having previously entered a station);
    e. Attempted use of a valid contactless EMV Smart Card beyond the limitations imposed on that card in respect of period passes (for example only five journeys per day on a daily pass).
6. Fare payment transactions and validations shall be sent to AFC Central Information System. This transmission shall be completed at the latest by midnight the day of the transaction. Transaction records must include at least the following:
    a. ID of card
    b. ID of terminal
    c. ID of location of transaction (with AVL information for validations on vehicles)
    d. Time of transaction
    e. Fare product
    f. Amount and result of transaction
7. Access gates shall be configurable to operate in either entry or exit mode to allow flexibility in terms of passenger flow. The unit must allow bi-directional traffic in one or both directions at a time.
8. Access gates should be supplied with separately wired emergency push buttons to set all gates open.
9. Access gates must store a transaction record for all transactions. Each transaction record must include at least the following:
    a. Date and time
    b. Unique ID of access gate
    c. Unique consecutive ID of that transaction in the system
    d. Transaction type identifier (based on fare type and payment media use)
    e. Value of transaction (or error)

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f. Unique ID of payment media in the transaction

10. Access gates must send all transaction records to the AFC Central Information Subsystem. The transmission of these transaction records must comply with the following:
    a. transaction records for all transactions must be sent the AFC Central Information Subsystem by 23hr59 on the day of the transactions, at the latest;
    b. all transmissions must be confirmed by the receiving device at the AFC Central Information Subsystem;
    c. communication must include standard algorithms to check possible errors in data transmission (and prevent recording of such erroneous output in the AFC Central Information Subsystem;
    d. in the event of a failed transmission, the access gate must retry data transfers until successful.
11. Fare Payment Devices must send all transaction records from contactless EMV Smart Cards to the City's Acquiring Bank, in compliance with all applicable banking standards and regulations.
12. The Fare Payment Device must be capable of receiving additional instructions from the Fare System, regarding identity of cards being used incorrectly (for example checked in but not checking out)
13. The Fare Payment Device must be capable of identifying (through the computation of a Message Authentication Code) where the integrity of the unsecured part of the NDoT AFC Data Structure is compromised, and record the identity of the card in such cases.
14. The Fare Payment Subsystem must be flexible enough to accommodate any additional requirements from the City's Acquiring Bank during the term of the Agreement, particularly in terms of how the transactions are recorded and sent. Such adaptations are envisaged as minor software changes, and shall be completed at no additional cost to the City.
15. Fare payment devices shall incorporate a passenger information display:
    a. the display unit shall be incorporated into the Fare Payment Device enclosure;
    b. by default, the last message will remain displayed until a next card is detected or 'time out', to be configurable based on business rules determined by the City from time to time;
    c. the format of indications on the display shall be clear and obvious to passengers;
    d. if the card is not accepted, the display shall display appropriate message in synchronisation with an audible alarm;
    e. the display shall be informative and instructional including at least the following:
        i. Out of service.
        ii. Go/proceed.
        iii. Seek assistance (flashing and audible alarm)
        iv. Insufficient value amount (ZAR)
        v. Card type.

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vi. Fare type.

vii. Fare due (ZAR).

viii. The entry/exit point reference/name,

4.3. FARE PAYMENT ON FEEDER VEHICLES

1. No physical access control is required for the Feeder Vehicles.
2. The Fare System Contractor will provide standalone validators (**"Fare Payment Devices"**) on all Feeder Vehicles (one unit per vehicle). Validators will be located near the driver, and the City will make some provision for mounting within the vehicles:
   a. the City's Vehicle Supplier shall provide the base support and placement pad for the fare validator unit, along with an electrical connection and some additional cabling;
   b. the Fare System Contractor will liaise with the City's Vehicle Supplier to determine any specific installation requirements.
3. The Fare Payment Devices will be installed on-board to validate contactless EMV Smart Cards presented by passengers upon boarding. It is envisaged that Feeder Routes will operate on a flat fare basis, so validation on exit is not required.
4. The Fare Payment Devices shall be:
   a. designed for operation with all contactless EMV Smart Cards issued by all PASA member banks;
   b. robust, durable, tamper proof and fit, form and function for purpose;
   c. maintainable (including provision for operational and maintenance mode switching) and equipped with fault diagnostics capability;
   d. similar in design and aesthetic appearance, irrespective of where used;
   e. capable of interfacing with the AFC Central Information Subsystem through the network infrastructure supplied by the Fare System Contractor; and
   f. capable of operating from the power provisioned and have internal battery backup.
5. The Fare Payment Device must be capable of receiving additional instructions from the Fare System, regarding identity of cards being used incorrectly (for example checked in but not checking out)
6. The Fare Payment Device must be capable of identifying (through the computation of a Message Authentication Code) where the integrity of the unsecured part of the NDoT AFC Data Structure is compromised, and record the identity of the card in such cases.
7. The Fare Payment Device must also:
   a. incorporate computing functionality to transact, process, display, store and report transit cards and bank cards interactions securely and separately;
   b. have sufficient local data storage capability for at least 48 hours of operational data, (no data shall be lost during any power outage);
   c. have the capability to store fare tables;
   d. be anti-collision enabled, regardless of the sequence of contactless EMV Smart Cards involved;

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e. incorporate at least a two line, 16 character LCD type displays (or equivalent visual indicators) and audible beepers to indicate the outcome of transactions to passengers.

8. On presentation of a valid contactless EMV card to a bus on-board entry fare payment device, the fare payment device must:
    a. initiate a secure communication dialogue with the card, in compliance with EMV Standards;
    b. validate the card in terms applicable transit products and/or prepaid stored value;
    c. display a green/red light and similarly display a readable relevant message and audible beeper to the passenger informing entry pass or not (in the case of unsuccessful validation, the driver shall be alerted);
    d. record and store the appropriate parameters on the contactless EMV Smart Card and on the Fare Payment Device, including card identification, time and date and location and a transaction authorisation code;
9. Fare Payment Devices must send all transaction records from contactless EMV Smart Cards to the City's Acquiring Bank, in compliance with all applicable banking standards and regulations.
10. The Fare Payment Subsystem must be flexible enough to accommodate any additional requirements from the City's Acquiring Bank during the term of the Agreement, particularly in terms of how the transactions are recorded and sent. Such adaptations are envisaged as minor software changes, and shall be completed at no additional cost to the City.
11. Fare payment transaction records must include at least the following:
    a. ID of card (or separate designation if cash)
    b. ID of terminal
    c. ID of location of transaction (with AVL information)
    d. Time of transaction
    e. Fare product (or separate designation if cash)
    f. Amount and result of transaction
12. Cash Box Requirement
    a. For Feeder Vehicles, a coin registering and validation fare box (**"Cash Box"**) is required to accept *occasional* payment by cash as a contingency option in the short term.
    b. The Cash Box must meet the following minimum requirements, and the design should be detailed as part of the tender return:
        i. discreet physical design, incorporated within close proximity of the driver, with future-proofing features in the event that cash is phased out of the system
        ii. closed unit to prevent handling of cash by driver or passengers once deposited in the unit;
        iii. secure unit and mounting, burglar proof and able to withstand non-legitimate attempts of forceful removal of the unit itself or the cash contained within it;

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iv. ability to accept and recognise coin denominations of ZAR5, ZAR2, ZAR1 and ZAR0.50c;

v. ability to reject and return illegitimate coins tendered, with minimum incidence of 'false acceptance';

vi. electronic interface with the Fare System Central Information Subsystem, to provide transaction data alongside that received through the Fare Payment Device;

vii. configurable for required fare value (which may be different from that deducted by the Fare Payment Device, in order to deter use of cash), and able to provide audible and visible indication of when the required fare value has been received;

viii. manual method for demarcating each transaction, for example by counting value or by a separate button for the driver to push

ix. ability to issue a paper receipt (or equivalent) with some configurable information printed on it, as evidence of payment received in the event of an inspection; and

x. method for secure removal of cash for vaulting, once the vehicle has returned to the depot (compatibility with standard methods used by cash management and transportation companies in South Africa is preferable).

13. Fare Payment Devices shall not permit a passenger to pass under the following conditions:

    a. Attempted use of invalid payment media (including variety of contactless smart cards which are not payment products issued by PASA member banks);

    b. Attempted use of a valid contactless EMV Smart Card but with insufficient value (at least minimum fare) or absence of valid transit product (such as a period pass);

    c. Attempted use outside IRT operational time;

    d. Insufficient value placed in the Cash Box.

14. All Fare Payment Device operations shall allow a minimum of 2400 passenger entries/exit per device per hour (assuming valid cards).

15. Fare Payment Devices shall incorporate a passenger information display:

    a. The display shall be a dynamic programmable TFT-LCD type or acceptable equivalent capable of displaying information in English as well as colour graphics and special characters.

    b. By default, the last message will remain displayed until a next card is detected or 'time out', to be configurable based on business rules determined by the City from time to time.

    c. The format of indications on the display shall be clear and obvious.

    d. If the card is not accepted or correct amount of cash placed in the cash box, the display shall offer an appropriate message in synchronisation with an audible alarm.

    e. The display shall be instructive and include at least the following:

        i. Out of service.

        ii. Go/proceed.

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iii. Seek assistance (flashing and audible alarm)
iv. Insufficient value amount (ZAR)
v. Card type.
vi. Fare type.
vii. Fare due (ZAR).
viii. The entry/exit point reference/name.

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5. PORTABLE CARD VALIDATORS (PCV)

1. The Fare System Contractor must supply hand held Portable Card Validators (PCV) for contactless EMV Smart Cards.
2. The PCV must be rugged, lightweight and autonomous, have a simple, user-friendly interface, a communication interface (wireless and wired) and provide services for both the inspector and the contactless EMV Smart Card holder.
3. The PCV shall be a portable handheld computer capable of:
    a. validating all contactless EMV Smart Cards (MasterCard PayPass or Visa payWave), regardless of issuer;
    b. verification of card status (in transit, checked in, checked out);
    c. providing card content information to passengers seeking assistance (e.g. remaining value);
    d. hosting fare payment media information (for example identified with repeated invalid use of product);
    e. being updated on regular basis; and
    f. enforcing a penalty regime (to be determined by the City and implemented by the Fare System Contractor, inclusive of amendments to the penalty regime as advised by the City from time to time).
4. The PCV shall be:
    a. supplied with a belt clip device for ease of handling and a communications cradle or internal interface;
    b. fitted with at least a 9 key alphanumeric keyboard, a sunlight readable touch screen display and fitted with an internal speaker and volume control;
    c. have a high performance card reader allowing the card holder to keep the transit card in hand;
    d. ruggedized and fit for purpose to address the challenges of the portable card inspection environment; and
    e. fitted with a rechargeable battery.
5. The PCV shall have:
    a. a control time of less than 0.5 seconds;
    b. transaction storage capacity greater than 1500 transactions; and
    c. autonomy of at least 1000 transactions or 8 hours.
6. The PCV shall interface with the AFC Central Information Subsystem via wireless depot communications infrastructure for upload/download of operating data, software updates, usage data, status and alarms.
7. The PCV data shall be used for analysis and reporting of inspector activities. Inspector shifts and related activity data shall therefore be recorded and a reporting system provided or interfaced to other central reporting.
8. Inspectors equipped with PCV shall travel on selected routes and move between stations and vehicles in accordance with an inspection regime (to be determined by the City and implemented by the Fare System Contractor, inclusive of amendments to the inspection regime as advised by the City from time to time) to perform the following key tasks:

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a. ensuring that passengers hold valid payment media and are validated when boarding;

b. assistance to passengers needing information, support with physical access (for example wheelchairs or pushchairs), or passengers holding defective cards;

c. enforcement of penalty regimes (to be determined by the City and implemented by the Fare System Contractor, inclusive of amendments to the penalty regime as advised by the City from time to time); and

d. provide physical security (presence) to passengers and operator personnel.

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6. AFC CENTRAL INFORMATION SUBSYSTEM

6.1. OVERVIEW

1. All software and hardware supplied or developed for the AFC Central Information Subsystem must be in compliance with the ICT Specifications provided in Part C3 Annexure D.
2. The Fare System Contractor shall design, develop and supply all central system hardware and software at the designated site.
3. The Fare System Contractor shall supply all offered equipment specifications and software specifications (including integration and installation) as part of the design document for approval by the City.
4. The Fare System Contractor shall provide the following minimum components for the Central Information Subsystem:
    a. central computers;
    b. third party and bespoke software to enable the functional requirements of the Fare System;
    c. at least three terminals with software and a laser printer; and
    d. a failover system.

6.2. FUNCTIONAL REQUIREMENTS

1. The AFC Central Information Subsystem shall provide the following minimum functionalities.
2. The Central Information Subsystem must
    a. have functions for cash management, fare payment transaction accounting and reconciliation, including calculation of daily total revenues;
    b. calculate daily total revenues;
    c. receive and store transaction records sent from all subsystems in the technical platform;
    d. store records of all bank deposits, for reconciliation with transaction records;
    e. keep a cumulative and parallel record of all activated City of Cape Town IRT Cards, for operational purposes;
    f. generate reports of transactions in the Fare System;
    g. provide functionality to create additional reports which may be required, and a tool for exporting information, so that data may be analysed by other database managers;
    h. maintain backup of all transaction records;
    i. maintain a failover infrastructure;
3. In terms of security access and administration, the Central Information System must:
    a. maintain a hierarchical architecture of access privileges to the Central Information Subsystem to guarantee that only authorised personnel can view data and no one has the right to erase data permanently;

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b. protect all information against loss, modification and unauthorised disclosure while stored or in transmission;

c. ensure the integrity of information received from the Fare System Contractor or the City, through provision of additional safeguards;

d. check and verify the authenticity of equipment and data transmitted from remote sources;

e. incorporate routines to detect fraud in the system, such as, but not limited to, checking that transit products do not exceed value added and checking integrity in the unique consecutive identifiers of all transactions in the system;

f. provide more general functions for administration of information within the Fare System by authorised users, including allocation of usernames and passwords, access to information, and modification of equipment settings;

g. provide the City with unlimited direct access, through a secure interface, to all databases within the Fare System; and

h. ensure outputs are compatible with the City's information systems.

4. In terms of asset maintenance and management, the Central Information System must:

a. record, control and administer the status and location of each asset in the Fare System (computer equipment, computer applications, furniture, parts and spares);

b. capture and send status reports on all equipment within the Fare System, (reports should be geared towards prioritising for immediate repairs and providing intelligence for preventative maintenance);

c. keep full records of maintenance history for each module or unit of equipment should be retained, including replacement units; and

d. monitor and manage the number of transactions by each item of equipment in order to undertake preventive maintenance and determine levels of spares in stock.

6.3. TECHNICAL REQUIREMENTS

1. The computers in the Central Information Subsystem must meet the technical requirements set out below.

2. At least two high-speed servers with communications equipment, backup unit configuration, appropriate to support the collection application installed. One of these central computers will be for the use of the Fare System Contractor, and the other for the exclusive use of the City.

3. The proposed system must have the capacity to manage a transaction volume of double the effective number of transactions in the system throughout the life cycle of the Agreement (details should be provided as part of the tender return).

4. The system must provide storage capacity for at least two years transactions in the Fare System, with full information access for reporting and mining of data.

5. The operating system shall be fit for purpose and industry standard. The City reserves the right to approve any operating system proposed by the Fare System Contractor.

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6. Workstations for system controllers shall be industry standard technology, with flat screens suitable for the working environment (minimum 17" and minimum resolution of 1600x1200 pixels).
7. Communication servers, application servers, database servers and storage infrastructure shall be fit for purpose for the AFC Central Information System.
8. The software licensing shall facilitate usage at the centre (and at depots if required). The City has preference for a concurrent licensing regime and non-preference for a server-based and user-based licensing regime. Provision shall be made for 30 concurrent licenses of the third party software in the central computers.

6.4. REPORTING REQUIREMENTS

1. The Fare System Contractor will supply to the City at least sixty (60) ready-made reports that will provide ongoing information on the operation of the Fare System.
2. During the detailed design stage of the Fare System, the Fare System Contractor will submit the sixty (60) required reports to the City for signoff and approval. Reports must include all subsystems and activities in the Fare System and shall include at least the following reporting areas:
    a. Card sales statistics;
    b. Card activation statistics;
    c. Card top-up statistics;
    d. Fare payment transaction statistics;
    e. Bank deposit statistics;
    f. Passenger movements, origin-destination;
    g. Payment media verification statistics (PCV Subsystem);
    h. Payment media security statistics;
    i. Transaction integrity statistics;
    j. Web statistics;
    k. Data transmission statistics;
    l. Suspicious or unusual transactions; and
    m. Maintenance statistics.
3. Generation of ready-made reports shall be easy. Any interface required to configure and generate the reports shall be provided as part of the Central Information Subsystem.
4. In addition to the ready-made reports, the system shall include a reporting engine. Statistical reports shall be quick and easy to generate and interpret and shall not require systems administration support. Reports shall be easily printable, exportable to standard spreadsheets, convertible to Portable Document Format (PDF) for distribution and to data formats such as Comma Separated Values (CSV) to enable analysis.
5. The applications shall offer functionality to collate all contactless EMV Smart Card transactions and communicate transaction logs to the Acquiring Bank/s in the most efficient manner. The Fare System Contractor in collaboration with the City's Acquiring Bank shall specify how this would be done.

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6.5. OPERATIONAL REQUIREMENTS

1. The operation of the data processing unit includes the administration of work and performance monitoring in the machine, security administration, database management, configuration management, development environment management and the management of storage devices and physical security in the computer centre, taking account of the following minimum specifications:

    a. *System optimisation and performance monitoring*. The Fare System Contractor will be responsible for the supervision, programming and ongoing operational management of the Fare System. If necessary, the Fare System Contractor shall proactively initiate maintenance of the system in order to maximize the efficiency of installed processing, and will provide a capacity plan to identify requirements for computer equipment in the future growth of the system.

    b. *Configuration management*. The Fare System Contractor will manage configurations and parameters in the Fare System both in lines and communication protocols, storage devices, printers, development environment, test environment, production environment, and all objects of the Fare System which require configuration.

    c. *Administration of the development environment*. The Fare System Contractor will administer the applications installed in the Fare System. Part of this process includes follow up on configurations and versions of installed applications, and programming the installation of new versions of applications, which must be approved in advance by the City without interrupting the operation of the Fare System. Distribution and programming should be automatic and centrally controlled.

    d. *Physical security for the data processing unit*. The Fare System Contractor will be responsible for the physical security of the data processing unit, access controls by authorised personnel in the premises of the processing centre, and the protection of equipment in order to avoid theft, vandalism, and etc, and must in addition abide by security measures ordered by the City, if the physical location of the data processing unit of the Fare System Contractor has common physical access with the Fare System.

    e. *Transmission of data to the data processing unit*. The Fare System Contractor shall be responsible for the transmission of information from point of sale transactions across the Fare System network. The Fare System Contractor shall be responsible for supply and maintenance of communications infrastructure. Each point of sale will have a time allocated to it at the end of the day at which it will automatically be connected to the data processing unit.

    f. *Updated fare rules*. Changes and additions to the fare rule structure will be reported to the Fare System Contractor by the City from time to time. The Fare System Contractor will update fare rules in all equipment in the system in its daily transmission with all Fare System devices.

    g. *Updates of computer applications*. Computer applications on all equipment at a given stop must be updated by remote action, and information on this must be transmitted to a local data consolidation unit, which will in turn update related equipment locally.

    h. *Information access for auditing*. All transactions undertaken on the Fare System equipment must be transmitted simultaneously to the designated

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City's computer and the Fare System Contractor's central computer, with no modification, in order to validate the data and check all transactions in the Fare System. The Fare System will also have the capacity to format information in files which may be easily read by any database manager, in order to detect problems.

6.6. DATA STORAGE AND BACKUP

1. The Fare System Contractor shall supply and install data storage and backup infrastructure at operational control centres.
2. Storage Area Networks (SAN) shall be deployed, with sufficient capacity for one rolling year of operational data.
3. Data shall be continuously backed up, to ensure it could be ported anytime to the failover infrastructure to resume operations within a reasonable time period (48 hours or less). The back up process must also include provision for daily safe off site storage of appropriate storage media.
4. Data storage and backup infrastructure shall include detailed operational and administration instructions, which in turn will form part of the systems documentation and related administrator training.
5. The Fare System Contractor shall safely store and maintain an exact copy of all the operational as built (or as installed) software of the complete systems. This shall be subject to periodic (bi-monthly) testing and certification (at the failover site).

6.7. FAILOVER INFRASTRUCTURE

1. Failover infrastructure (application and database servers) shall be supplied and installed at the failover site to act as temporary operational centre in case of disaster that causes the main operation centre to become inoperable.
2. Failover servers at the failover site shall be operationally ready (all server operating software installed) to receive the applications software.
3. Failover sites shall be subject to periodic (bi-monthly) testing utilising the stored copy of the applications software.
4. Latest backups from the main operational site and the stored copy of the applications software shall be deployed in the failover site in case of disaster at the main operational site.

6.8. ITS INTERFACE

1. The Fare System Contractor must have an awareness and understanding of the overall architecture for the ITS Implementation supporting the IRT, of which the Fare System forms just one part.
2. The Fare System must provide for detailed interfaces with the APTS for consolidation of all operations and transactions taking place on each and every item of equipment installed at each stop, forming a database to store and transmit that data regularly to the AFC Central Information Subsystem.
    a. The consolidation unit will be composed of one server and peripherals which will enable it to receive information from equipment at the stops, and send it to the AFC Central Information Subsystem.

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b. The Fare System Contractor shall supply prototype interfaces for each inter-system interface to the other contractors as part of the integration process.

3. As part of the criteria for developing these interfaces, the Fare System Contractor shall take into account the need for public information through the internet, as detailed in Section 7.
4. The Fare System Contractor shall work collaboratively with the City and with third parties (as directed by the City), to ensure the interface is operational and fit for purpose.
5. The Fare System Contractor shall develop all interfaces for data exchange and interfacing with other ITS sub-systems and transport regulation data bases to open standards.

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7. WEB SUBSYSTEM

1. The Fare System Contractor shall deliver an AFC Web Site ("**the site**"), in compliance with the ICT Specifications provided in Part C3 Annexure D.
2. The Fare System Contractor shall be responsible for integration and set up of the web site and shall ensure that it is W3C compliant and that it follows the latest Web Content Accessibility Guidelines (WCAG).
3. Requirements for back office integration of the Fare System with the APTS have already been presented in these Specifications.
4. The site shall incorporate fare regimes, transport options and where and how to obtain fare media. It would necessarily include the topology (map) of the IRT showing access points.
5. The site shall provide a portal for displaying additional pages from other websites developed by the City.
6. The site shall be accessible to anyone with access to the internet.
7. The site shall include a secure portal for ordering and prepayment of a City of Cape Town IRT Card for collection at a designated point.
8. The Fare System Contractor shall develop the site with input from the City (including branding, colours and graphics). Page layouts, menus and page information shall be provided for review and approval by the City.
9. The Fare System Contractor shall work with third parties as directed by the City to incorporate and present transit availability information for IRT passengers via the site.
10. The Fare System Contractor shall be responsible for the design and development of the site, including all required scripting, whether HTML, Java, Flash, etc. and integration with Fare System and ATMS.

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8. COMMUNICATIONS SUBSYSTEM

1. The City shall provide information regarding the communications infrastructure being made available for the IRT System.
2. For the development activities relating to the Fare System, the Fare System Contractor will request, under its own responsibility, such telephone lines or other communications services as it may require for voice and data communications and transmission required for system delivery.
3. The cost of installation and billing of the service will be paid by the Fare System Contractor.
4. The Communications module will comply with at least the following functional specifications:
    a. Transmission of transactions. Communications services must have the capacity required to transmit and receive information of the validations of entry and exit, sales, failure alarms, lists of means of payment not valid for the Fare System, and updating of the tariff structure between the data consolidation unit from each stop, and the data processing unit.
    b. Communications protocols. The asynchronous communication will be effected on file transfer protocol, on TCP/IP. The Respondent shall provide a communications plan detailing how devices and systems will communicate with the data processing unit.

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ANNEXURE B:

ELECTRICAL INSTALLATION SPECIFICATION

(CONDENSED)

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CITY OF CAPE TOWN

TRANSPORT ROADS & STORMWATER

CONTRACT NO. 24G/2009/10

DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING, AND COMMISSIONING OF THE IRT FARE SYSTEM, THE SUPPLY AND DISTRIBUTION OF FARE CARDS, AND THE PROVISION OF MAINTENANCE AND OTHER RELATED SERVICES

SCOPE OF WORKS

ANNEXURE B: ELECTRICAL INSTALLATION SPECIFICATION – CONDENSED

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SPECIFICATION : ELECTRICAL

1 GENERAL

This specification comprise of all aspects regarding the electrical installation for the new BRT stations and associated electrical works in the greater Cape Town Metropolitan area.

All work shall be scheduled in liason with the Main Contractor to suit his master program.

2 SCOPE OF WORKS

The scope of the installation shall comprise of:

- Distribution board installation
- Cable installation
- Lighting installation
- Power socket outlet installation
- Wiring and wireways
- Earthing and bonding
- Labelling
- Site supervision
- Production of “as-built” drawings

3 STANDARD SPECIFICATIONS, REGULATIONS AND CODES

3.1 The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

3.1.1 Occupational Health and Safety Act of 1993

3.1.2 SANS 10142-1 – Wiring of premises 2003

3.1.3 SABS 0400 – Building regulations

3.1.4 SABS 0313 – Earthing of structures

3.1.5 Manufacturer's specifications and installation instructions

3.2 The Contractor shall ensure that all safety regulations and measures are applied and enforced during construction, repair and maintenance work on cabling, wiring, distribution boards, luminaires and power outlets.

3.3 The Contractor shall ensure that his company is registered to execute work in the Cape Town Metropolitan area.

4 CONSTRUCTION PROGRAMME

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The Contractor's programme shall be co-ordinated with the programme of the Project Manager and shall include allowance for adverse weather conditions, builders holidays and public holidays as specified in the Contractor's Conditions of Contract.

5 STORAGE

The Contractor shall provide adequate and safe storage for all materials. All materials shall be stored or stacked in positions that will not interfere with other work in progress in the area.

6 QUALITY OF MATERIALS

6.1 All materials supplied or utilised under this Contract shall be new and unused. Only materials of first class quality and finish shall be utilised. All materials shall be subject to prior approval by the Engineer.

6.2 All materials shall comply with the relevant SABS specifications.

6.3 All materials shall be unconditionally guaranteed for a period of 12 months from the date of practical completion, which is first hand over. Where Supplier's guarantees are of a shorter duration than 12 months, the Contractor shall unreservedly agree to the extension and cession of all warranties and guarantees.

6.4 The Contractor shall replace any materials that are found to be defective during the 12 months contractual defects liability period.

7 COMPETENCE OF PERSONNEL, WORKMANSHIP AND STAFF

7.1 All work shall be executed and supervised by suitably qualified staff. Only "ACCREDITED PERSONS" shall be permitted to carry out and supervise work.

7.2 The Contractor shall at all times have an adequate number of employees available during the construction period to ensure that the work does not delay the construction programme.

7.3 The works shall be supervised by a full time registered "MASTER ELECTRICIAN".

8 CO-ORDINATION OF SERVICES

The Contractor shall be responsible for the on site co-ordination with the Principal Contractor and other sub-contractors. Due allowance shall be made for this liaison and on-site co-ordination in the tender price.
Continuous liaison with the electronic services contractors will be required as the electrical and electronic work will have to be done in the same enclosures.

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9 FINISHING AND TIDYING

9.1 In view of the concentration of construction and other activities likely to be experienced during the Contract period, progressive and systematic finishing and tidying will form an essential part of this Contract. On no account will soil, rubble, materials, equipment or unfinished operations be allowed to accumulate in such a manner as to unnecessarily impede the activities of others. In the event of this occurring the Employer will have the right to withhold payment for as long as may be necessary in respect of the relevant Works in the area(s) concerned, without thereby prejudicing the rights of others to institute claims against the Contractor on the ground of unnecessary obstruction.

9.2 Finishing and tidying shall therefore not be left to the end of the Contract, but shall be a continuous operation.

10 EXISTING WORKS AND SERVICES

The Contractor is responsible for obtaining information regarding services and the existing works which may be affected by the new works. Before the Contractor commences operations, he must discuss with and have the approval of the Project manager concerned regarding the method he proposes to use for the safeguarding of any services and existing works he may encounter during construction. The cost of all precautionary measures, which may be necessary to ensure the safety of such services and existing works, as well as the protection of all persons, shall be borne by the Contractor. Any alteration to services, which may be required, shall be carried out by the Authority concerned at the expense of the Contractor. The Contractor shall be held responsible for any damage, injury or accident caused as a result of his failure to take the necessary precautionary measures.

11 SUPERVISION

Work shall at all times be subject to full time supervision by a qualified and experienced Site Agent. This representative must be authorised and competent to receive instructions on behalf of the Contractor.

12 PROTECTION OF OTHER SERVICES AND STRUCTURES

12.1 The Contractor shall take all the necessary precautions to protect existing services, finishes and structures during the execution of the Contract, and shall be fully responsible for all repairs and damages thereto. The costs for any repairs of damages shall be recovered from the Contractor.

12.2 The Contractor shall also exercise extreme care when excavations are made, to avoid damage to existing or newly installed services. Any damages to other services shall be rectified forthwith and the costs for the rectification will therefore be recovered from the Contractor.

13 WORK BY OTHERS

13.1 Extensive on-site liaison between the different Contractors will be required as this is a fast track, multi-disciplinary project.

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13.2 The bulk electrical supply will be provided by Messrs. xxxxxxx

13.3 The electronic systems will be supplied and installed by Messrs. xxxxxxxx The latter will also be responsible for rack wiring and IP structured cabling.

14 CABLE INSTALLATION

14.1 General

14.1.1 All power cables shall have stranded copper conductors, shall be of the 600/1 000V PVC/SWA/PVC type.

14.1.2 Sleeves, where specified, shall be Nextube, Kabelflex, minimum diameter of 50mm. Rigid 'slow bends' shall be installed where these sleeves exit from the soil trenches.

14.1.3 Where sleeves are not specified, armoured cables shall be laid directly in the ground. Minimum laying depths shall be 650 mm below final ground level unless otherwise specified, and routes shall be as indicated on the drawings. The Contractor shall contact the Engineer regarding theft mitigation measures to be implemented.

14.1.4 The Contractor shall use hand excavation to minimise risk of damage to the numerous existing services.

14.1.5 All trenching, including excavations, bedding layers, shoring and prevention of waterlogging, drainage of excavations, backfilling and compaction of trenches form part of this contract. The Contractor shall be deemed to have allowed for the laying of cables, terminal boxes, glands and termination of cables. Trenches shall be compacted to a minimum of 93% of modified AASHTO density during backfilling.

14.1.6 Tenderers shall take cognisance of the fact that other services might be installed along the same routes as the cables. The Contractor shall, before commencing with any excavations, peg out the proposed cable route and confirm it with the Engineer.

14.1.7 Positions of concrete cable markers shall be pegged on site in collaboration with the Engineer. The wording of the aluminum labels shall be provided by the Engineer.

14.1.8 Tenderers are to note that some cables will be installed underneath paved areas. The Contractor shall be required to provide appropriate machinery for this type of installation and shall allow in his tender price for hiring of such machinery and the remedial civil work associated with this installation.

15 DISTRIBUTION BOARDS

15.1 Distribution boards shall comply with the requirements of IEC 439-1.

15.2 The distribution board requirements are as shown on the schematic drawings. Note 5 kA minimum fault level.

15.3 Note that overvoltage protection is required at every DB, with the exception of UPS DB's.

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For single phase DB's, the Contractor shall install DIN rail mounted Dehnguard and Dehngap plug-in modules. The modules shall be earthed by means of 4mm insulated wiring.

15.4 Electrical Contractors are advised to order the distribution boards and equipment from a reputable Manufacturer, as inferior boards will not be accepted.

15.5 Shop drawings shall be submitted to the Engineer for formal approval before any manufacture commences.

15.6 It shall further be noted that late approval of drawings and distribution boards due to non-compliance with the specification will not relieve the Electrical Contractor from his obligations to complete the installation according to the programme. No claims for delays or extension of time in this regard, will be entertained.

15.7 All phase, neutral and earth busbars shall be adequately sized to accept all circuits and connections.

15.8 Door hinges shall be of the Perano manufacture. The steel doors shall be padlockable.

15.9 The front face panels shall be secured by means of the Perano type catches. Catches with slots or square key formats will not be acceptable.

15.10 The distribution boards shall be powder coated and colour shall be as specified. Powder coat quality shall be verified during distribution board tests.

15.11 All distribution boards must be inspected and accepted in the factory prior to dispatching. The exact wording of the engraved labelling shall be finalized during the pre-handover inspection.

16 POWER SKIRTING; CABLE TRAYS; TRUNKING AND CONDUITS

16.1 Cable trays

16.1.1 Cable trays shall be of the heavy duty Cabstrut type or approved equivalent trays. The cable tray width shall be as specified on the relevant drawings. Only purpose-made splices, risers, offsets and bends shall be used.

16.1.2 Trays shall be fastened onto lengths of P2000 unitstrut. Each unistrut section shall be fixed to the structure with 8 x 80 mm expansion bolts. Unistrut spacing shall be 600 mm maximum.

16.2 Power skirting

16.2.1 Power skirting, where specified, shall be 2 compartment Cabstrut Venus Modular PVC power skirting.

16.2.2 Power skirting shall be supplied complete with purpose-made faceplate equipment and all the necessary accessories including covers, bends, clip-on partitions, etc.

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16.2.3 Power skirting shall be used for power, data and telephone wiring and outlets shall be the Crabtree range.

16.2.4 The power skirting shall be linked to the distribution board by conduit installed to a pre-manufactured conduit entry unit behind the power skirting. The power skirting shall be clearly marked on the front cover “conduit entry”. The conduit links shall be routed inside chipped floor screed.

16.2.5 The same arrangement shall apply at positions where power skirting are interlinked. A minimum of four 20 mm diameter PVC conduits shall be installed in each case; i.e. power 2x, data 1x, and telephone 1x. The Tenderer shall allow in his price for drilling through walls and chipping in the floor for the interlinking conduit where indicated on drawings.

16.2.6 Any resulting damage to completed finishes will be rectified to the satisfaction of the Principal Contractor and the Project manager, at the Contractor’s expense.

16.2.7 Extreme accuracy will be required during marking out to ensure that the conduit entries exiting the floor slab and walls are positioned correctly.

16.3 Trunking

16.3.1 Steel trunking, where required, shall be the hot dip galvanised Cabstrut type complete with elbows, tees and covers. The width shall be as specified on the relevant drawings. Trunking shall be powder coated. Colour to be approved by the Architect.

16.4 Conduit

16.4.1 Internal conduits shall be PVC and installed flush inside walls and slabs and surface mounted in ceiling voids. No conduit installation on the wall surfaces shall be permitted in the building.

16.4.2 Conduit work under open roof structures and inside ceilings shall be done in a rectangular grid pattern. Steel saddles shall be used inside ceilings. Caddy clamps shall be used on roof purlins, maximum spacing of saddles and clamps shall be 750 mm.

16.4.3 All external conduits exposed to sunlight or rain shall be Bosal-type galvanised steel. Aluminum hospital conduit saddles shall be employed. External draw box covers shall be sealed with white silicone after the installation has been completed.

16.4.4 Chasing where applicable, shall only be done with a twin-blade chasing angle grinder or approved methods. Prior approval must first be obtained from the Architect or Engineer before any chasing work is carried out.

17 LIGHTING INSTALLATION

17.1 General

17.1.1 Light fittings shall be delivered to site in boxes as packed by the Manufacturer. When the installation is handed over, all light fittings shall be in a working condition, new and unused.

17.1.2 The permanent light fittings intended for installation shall not be used for temporary lighting during construction. The certificate of completion for the installation will not be finalised, unless all light fittings and lamps are in working order.

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17.1.3 All fluorescent type light fittings shall be equipped with 26 mm diameter tubes, generally 1200 mm long and with a colour temperature of 4300 °K (cool white) and minimum colour rendering index (Ra) of 64. The Engineer will reject unmarked lamps. All costs to replace these lamps with marked lamps will be for the Electrical Contractor's account.

17.1.4 All light fittings and light fitting components shall be approved by the Engineer and capacitors and ballasts shall bear the SABS mark of approval.

17.1.5 Fluorescent tubes shall have bi-pin end cap arrangements and shall fit into telescopic spring assisted lamp holders to ensure that the lamps are always secure.

17.1.6 The metal body parts shall be finished in white epoxy powder coating for maximum reflectance.

17.1.7 Ballasts shall be of the electronic Osram or Tridonic electronic type and shall be power factor corrected to ensure a power factor better than 0,9.

17.1.8 The Contractor shall submit samples for approval of all types of light fittings to the Engineer prior to procurement thereof.

17.1.9 Lamps shall be Osram or Philips manufacture.

17.2 Light switches

Light switches shall be rated at 16A, similar or approved equal to Crabtree manufacture, complete with white cover plates.

17.3 Schedule of luminaires

All light fittings shall be supplied complete with lamps.

The schedule of luminaires shall be issued once the design has been approved.

18 POWER SOCKET OUTLETS

18.1 For the power installation, the Contractor shall be responsible for: -

- Supply and installation of 16A switch socket outlets.
- Supply and installation of isolators for fixed equipment, geysers and aircon.
- Wiring of all circuits back to the DB's.
- Labelling of all outlets as specified.
- Testing of all circuits.

18.2 Socket outlets

18.2.1 Wall-mounted socket outlets shall be similar or approved equal to 16A Crabtree type complete with cradle and white socket outlet cover plates for normal power. Red socket outlet cover plates for UPS power shall be used.

18.2.2 Single and double socket outlets shall each be mounted in a flush-mounted in a horizontal 100 x 50mm wall box or in the power skirting.

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18.2.3 UPS circuits, feeding the power distribution modules inside the equipment cabinets, shall have insulated 2.5mm² earth cable back to the UPS DB.

18.3 Isolators for equipment racks and fixed appliances

Isolators shall be flush or surface mounted and shall be similar and equal to the Crabtree range with 20A double pole isolator and cord grip.

18.4 Industrial switch socket outlets

Three phase units – where specified - shall be similar or equal approved to the Waco 5-pin type 123356 IP57 unit. One straight plug top type 203356 is required with every outlet.

19 TELEPHONE OUTLETS

Not applicable; telephones shall be IP-based.

20 WIRING

20.1 Surfix or Norse cable shall not be accepted on this site. Only SABS general purpose stranded copper wiring shall be accepted.

20.2 All circuits shall be wired from fresh unused coils of red, white, blue and black conductors. The colours of conductors shall correspond to the phase from which that circuit is fed. An alternative colour may be used for the switched conductor between the light switch and the light fitting. The use of insulation tape to indicate phases will not be accepted.

20.3 Wiring shall not be drawn into conduit until the conduit installation has been completed, fitted with bushes and all moisture and debris have been removed.

20.4 Joints of any kind will not be permitted in wiring. No more than 2 single or 1 three phase circuit may be drawn into any conduit.

20.5 All conductors shall be marked by suitable cable markers indicating the circuit (e.g. L1 on both line and neutral conductors) at either end.

Circuit	Minimum conductor (size)	
	Phase (mm²)	Earth (mm²)
Lighting power supply	2,5	2,5 bare
Switched socket outlets & Isolators	4,0	2,5 bare
UPS Switched socket outlets	2,5	2,5 insul

21 EARTHING AND BONDING

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21.1 The Electrical Contractor is to ensure that the installations covered in this document are effectively earthed and bonded in accordance with the requirements of the SABS 0313.

21.2 An earth mat will be installed underneath each kiosk surface bed to ensure an earth resistance of less than 1 Ohm. This work shall be done by Others.

22 LABELLING OF CIRCUITS

All outlets, isolators and light switches shall be labelled with engraved labels on the cover plate. The label shall indicate the supply DB and circuit number (e.g. DB-6-L5). Wiring inside the DB shall be bear Gravoplast labels.

23 INSPECTIONS

23.1 The Electrical Engineer's or Client's representative will inspect the installation at any time. All inferior, unsuitable, unacceptable or rejected work shall, if indicated by the inspecting officers or the Engineer, be removed and shall be rectified by the Electrical Contractor at his own expense. Under no circumstances will these inspections relieve the Electrical Contractor of his obligations in terms of the document nor will these inspections be regarded as final approval of the works or portions thereof.

23.2 Where, inspections are requested by the Contractor, the Electrical Engineer's or Client's inspection shall only be carried out after the Contractor has carried out his own preliminary inspection to ensure that the Works are completed and comply with the documents. The Electrical Engineer's or Client's inspection shall therefore not be regarded as supervision, fault listing, quality assurance or site management.

24 SITE TESTS AND COMMISSIONING

24.1 The following minimum site tests shall be carried out by the Contractor and the results presented to the Engineer:

24.1.1 insulation resistance between all conductors and earth

24.1.2 insulation resistance between all conductors and neutral

24.1.3 insulation resistance between all 3 phase conductors

24.1.4 polarity of light switches

24.1.5 earth leakage protection

24.2 After submission of the test results, the Contractor shall notify that the installation is complete, tested and in working order.

The Client or the Engineer will witness the re-testing of the installation.

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25 CERTIFICATE OF COMPLIANCE

25.1 All work covered under this contract or that has to be carried out on site, must be executed by a qualified and fully representative person. Only persons registered as an “installation electrician” will be accepted to carry out the installation work. After completion of the contract, the Contractor shall submit to the Engineer a certificate of compliance in terms of legislation prior to final payment being processed.

25.2 One Certificate of Compliance is required per electrical DB completed, and the certificate shall cover all downstream works.

26 AS-BUILT DRAWINGS AND DOCUMENTATION

The Contractor shall prepare as-built drawings of his cable trenches, earthing cable layout as well as all the conduit routes.

27 12-MONTH DEFECTS LIABILITY PERIOD

27.1 The equipment and installation supplied under this contract shall be guaranteed for a period of twelve months from date of acceptance by the Engineer in all respects and commissioned for continuous service. The tender price shall include for the above.

27.2 The defects liability will be for a period of twelve months, calculated from the date of issue of the Certificate of completion by the Engineer. Retention funds will be reduced to 5% upon the commencement of the defects liability period. The balance of the retention money will be paid out after the lapse of the defects liability, provided the installation has operated in a stable and satisfactory working order during this period.

27.3 The Contractor shall be responsible for the replacement of all missing draw wires and conduit accessories during the contractual 12 months defects liability period.

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ANNEXURE C:

ELECTRONIC SYSTEMS REQUIREMENTS

(CONDENSED)

CITY OF CAPE TOWN

TRANSPORT ROADS & STORMWATER

CONTRACT NO. 24G/2009/10

DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING, AND COMMISSIONING OF THE IRT FARE SYSTEM, THE SUPPLY AND DISTRIBUTION OF FARE CARDS, AND THE PROVISION OF MAINTENANCE AND OTHER RELATED SERVICES

SCOPE OF WORKS

ANNEXURE C: ELECTRONIC SYSTEMS REQUIREMENTS

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PS1 SCOPE

This specification covers the requirements for the supply, delivery, installation, testing and commissioning to provide reliable and safe electronic systems.

PS2 STANDARDS

The latest edition, including all amendments up to date of tender of the following particular national and international specifications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

a) Radio Act No. 3.

b) Regulations of the Department of Posts and Telecommunications.

c) Electronic Communications Act No 36

PS3 ELECTROMAGNETIC COMPATIBILITY

PS3.1 Equipment is often required to operate within it's specified limits adjacent to radio transmitters.Electromagnetic compatibility design principals shall be incorporated to accommodate this application. To allow system integration, the equipment capability to withstand RF field strength shall be clearly stated.

PS3.2. The design shall also provide measures to eliminate electromagnetic radiation from the equipment and if applicable, the technical specification for this shall be provided.

PS3.3. All equipment to be used shall be suitably suppressed against radio frequency interference which may be introduced by operating radio transmitters in the equipment room. The Tenderer is required to indicate the maximum RF field strength that the equipment can handle satisfactorily. If this information is not supplied, it will be assumed that the equipment offered is suitably suppressed for all operating conditions. All electromagnetic radiation shall comply with the requirements of the Radio Act, Act No. 3 of 1952 and the Electronic Communications Act of 2005 No 36.

PS4 DESIGN REQUIREMENTS

PS4.1 Electrical supply circuits

(a) The design shall incorporate methods to protect personnel from accidental contact with potentially dangerous currents and voltages.

(b) The equipment shall have a clearly labelled power ON/OFF switch. The power input side of the switch and the incoming power line connections shall be given physical protection against accidental contact. The equipment shall comply with the relevant sections of the applicable SABS, IEC and BS safety codes and standards.

PS4.2 Electrical connectors

Connectors shall be selected so that it will be impossible to insert the plug in a receptacle other than the intended electrical cord.

PS4.3 Current overload protection

(a) Protection devices such as fuses, circuit breakers, thermal cut-outs, and solid state current interruption devices shall be used.

(b) Fuses providing protection to the equipment shall be located so that they are readily accessible and in a convenient location. At least one extra fuse of each type and rating used shall be supplied and attached to the applicable unit of equipment. Panel mounted fuse posts shall be such to permit renewal of fuses without the use of tools.

(c) Restoring of switching devices such as circuit breakers, shall be readily accessible to the operator. The circuit breaker shall give a visual indication when the breaker is tripped.

PS4.4 Thermal Design

(a) Adequate steps shall be taken in the design of the equipment, in order to maintain equipment parts within their permissible operating temperature limits.

(b) Where necessary, the design shall incorporate temperature sensing devices, to prevent thermal run-away. If it is not desirable to completely shut off the equipment, the performance of such equipment will be reduced to a lower level until the temperature has dropped to a safe level.

(c) It is preferable to use cooling techniques based on radiation and free convection. External devices such as cooling fans shall only be used when natural cooling can not be accommodated.

PS4.5 General Construction

(a) All control switches, handles etc. shall be so designed and positioned in relation to other fittings as to be easily accessible.

(b) All instrument dials and indicating devices such as displays, shall be fitted in such a manner as to be clearly visible from the operator's normal position.

(c) Fuses and circuit breakers shall (where applicable) be mounted on the exterior of the equipment and be easy accessible.

(d) Adequate test and measuring points shall be incorporated in the design to facilitate ease of testing.

PS4.6 Printed Circuit Boards (PCBs)

(a) Maximum use shall be made of plug-in printed circuit boards using reliable, high quality components. The boards shall be designed to operate satisfactorily under worst- case conditions.

(b) The printed circuit boards shall be of high grade glass epoxy copper clad laminate. Phenolic or bakelised paper board will not be accepted.

(c) The boards shall be of a thickness which is compatible with the weight of the components mounted on it, but in any case, shall not be less than 1,0 mm.

(d) The boards shall have an adequate copper laminate of at least 600 gm/m² (2 ozs/ft²).

(e) In general, printed circuit boards shall conform to BS 4025 or equivalent. If multi layer printed circuit board is used, the connections through the board shall be plated through holes in accordance with BS 4597.

(f) Particular attention will be paid to the hole location and size tolerance, the conductor thickness and width, the conductor spacing, the diameter of the holes relative to the component legs and the size of the solder pads and holes.

(g) The minimum distance between the conductive tracks on the edge of the printed circuit boards and any adjacent conductive surface, such as frames, shall be calculated as follows: 0,035 mm per volt + 0,35 mm. Boards that slide into guide rails or supporting structures, shall have a minimum conductor to guide distance of at least 2,5 mm. (This requirement is not applicable to ground planes or heat sinks). Tin lead plating shall be used to plate printed circuit boards to facilitate soldering.

(h) Printed circuit boards shall be treated with a polymer conformal coating, after the production process to prevent the ingress of moisture and growth of fungus. Parts such as connectors,

switches and adjustable components where mechanical movement is required to align and tune the electronic circuit, shall be protected during the application of the conformal coating.

(i) All printed board sockets, plugs and edge connectors are to be hard gold plated. The insertion and withdrawal force and the contact pressure and area for each connection method proposed is to be such as to ensure good and reliable contact under all circumstances.

(j) Multi pin high quality plugs and sockets are preferred rather than printed board edge connectors.

(k) Each plug-in card shall be polarised by means of a mechanical key to prevent a card from being plugged into a socket for which it was not intended, and to prevent a card from being inserted upside down. The key must be demonstrated to be permanent and not capable of being removed by the action of withdrawing the plug-in card. If this is not possible with the equipment offered, then the terminals shall be so arranged that no damage shall result if a card is accidentally or intentionally inserted into the wrong slot.

(l) All components and parts shall be mounted on one side of the printed circuit board only. All components shall be so mounted as to not obscure access to any terminations of any other parts. No portion of any component attached to the printed circuit board shall extend beyond the edge of the printed circuit board.

(m) Components and parts designed to be mounted with mechanical fasteners shall be mounted so as to withstand all vibrations and mechanical shock hazards encountered during normal road transport.

(n) No lead bend radius shall be less than the lead diameter.

(o) All components and parts shall be located and spaced so that any part can be removed from the printed circuit board without having first to remove another part. Parts shall not be placed across or on top of each other.

(p) The frames into which the cards are plugged shall provide rigid and positive support and location for the card over the whole length to prevent rocking of the card in the container. Standard 482mm (19 inch) rack units will be preferred.

(q) Component identification is essential and for this purpose the use of silk screen printing on the printed circuit boards is recommended.

(r) Each card shall have the following information printed on it:

(i) Name

(ii) Drawing/type number

(iii) Component identification in accordance with the associated circuit diagram

As an alternative to (iii) a separate drawing may be provided to show component identification.

(s) The following drawings for each and every printed circuit board type shall be supplied.

(i) Complete circuit diagrams.

(ii) Drawings showing the layout of components with reference to the circuit diagrams in (i) above.

(iii) Drawings showing the printed circuit layout (one copy for each layer of the board in the case of multi layer).

The above drawings shall form part of the maintenance manuals to be supplied for the equipment.

(t) Extender cards to elevate any printed circuit card above the normal supporting frame shall be supplied to enable maintenance and alignment procedures while the system is in an operational state, where on such cards, adjustment and measuring points are not easily accessible.

PS4.7 Components

(a) Only components with at least one and preferably two sources of alternative supply are to be used. Components shall be of the JEDEC-coded type where possible. If the components are labelled with type numbers other than registered JEDEC numbers, then a list giving alternative replacement number shall be provided.

(b) Preference will be given to systems utilising large scale integrated circuits that are generally obtainable from the major component manufacturers. Specially developed components shall be avoided as far as possible.

(c) The equipment shall not contain thermionic devices. (This includes the cathode ray tube required for the terminal equipment, where specified). All semi-conductor components used shall be of the silicon type unless otherwise approved.

(d) The use of electrolytic capacitors shall be kept to a minimum. Where they can not be avoided they shall have a guaranteed life time in excess of 100,000 hours, The capacitor elements and internal connecting leads shall be aluminium and no aluminium to copper joints shall be allowed inside the capacitor. Capacitors are not preferred in circuits which are responsible for basic clock pulse generation.

(e) Any relays used shall preferably be of the sealed contact type or mercury wetted reed relays and shall be equipped with resistor/diode suppression circuits across the coil to eliminate inductive transients. Diodes shall be of the fast recovery types with an inverse voltage rating of at least double that of the relay supply voltage.

(f) The resistance value shall not exceed that of the relay coil. Failure of a relay contact or associated components shall not cause an undesired command to be given from the device in the case of output circuits. Where relays are used in input circuits, failure of the relay and/or contacts shall result in the generation of an alarm signal.

(g) Indication devices shall use lamps of a locally produced type and preferably only one type of lamp shall be used throughout the installation. All lamps shall be easily replaceable from the front of the equipment, and if a lamp extractor is needed, minimum one unit shall be provided for each location.

(h) Where lamps are transistor driven, a series resistor shall be incorporated in the circuit to protect the transistor against cold switch-on surges. Each resistor shall be mounted close to the transistor and shall be rated such that the surface temperature rise is no more than 10°C above ambient under worst case conditions.

(i) Annunciator shall incorporate at least two lamps in parallel and lettering shall not be less than 2,5 mm in height. The annunciator windows shall be large enough to accommodate the English and tag number inscriptions in one window unless otherwise specified. Each window shall be able to accommodate at least 50 characters without endue crowding.

PS4.8 Connectors

(a) The practice of soldering wires directly onto the printed circuit board shall not be permitted. Connectors will be used as far as possible. The design shall make provision for the connectors to be situated on one side of the PC board only.

(b) Preference will be given to connectors which will be fitted to cables which provide some form of grip to discourage the practice of pulling the cable to release the connector. Connectors shall be provided with some means of retention adequate to the conditions of use.

(c) Where similar connectors are so placed that possible mis-mating could occur, the connectors shall be provided with alternative inserts, key way setting etc. in addition to the clear identification markings.

(d) Only high quality connectors suitable for the application shall be used.

PS4.9 Wiring and Wiring harnesses

(a) Wiring harnesses shall not restrict the easy replacement of parts of components which may require replacement or adjustment.

(b) Wiring routes shall be planned to avoid hot spots and to preclude the possibility of the use of wires as hand holds.

(c) Wires shall be routed to avoid the formation of current loops.

(d) Where a harness is terminated in a connector mating with a connector fixed to an assembly, flexibility of the harness shall (where applicable) be such to allow the insertion of a test adapter between the harness termination and the assembly.

(e) Wires shall not be carried over or bent round any sharp corner or edge without suitable protection.

(f) Sufficient slack shall be left at the ends of wiring runs, to allow for the displacement of components to which they are attached, for inspection and servicing. All wires in a wiring harness shall be clearly identified by means of colour coding or other suitable means. Clamps designed to support the wire harness shall be such that it will not affect the mechanical or electrical performance of the wires adversely.

PS5 ADDITIONAL REQUIREMENTS

PS5.1 Galvanic corrosion

When dissimilar metals are used in intimate contact, suitable protection against galvanic corrosion shall be applied.

PS5.2 Accessibility

(a) Each item of equipment on each major sub-assembly shall provide for the necessary access to its interior parts, terminals, and wiring for adjustments, required circuit checking, removal and replacement of maintenance parts.

(b) The unsoldering of wires, or wire harnesses, parts or assemblies for routine maintenance purposes in order to gain access to terminals are not acceptable.

PS5.3 Ergonomics

Ergonomic design criteria and principals shall be applied in the design of the electronic equipment so as to achieve effective performance by the operator, maintenance and control personnel and to minimise the skill requirements.

PS5.4 Identification and marking

(a) Every assembly unit shall be marked with its serial number and version number and if applicable its part number.

(b) When applicable, all controls, test points, components, functional markings, fuse designation and ratings, power supply polarities etc. shall be marked adjacent to the item itself.

(c) Labels shall preferably be of metallic material and revited or screwed to the chassis or mainframe. Self adhesive labels shall not be used.

PS6 SOFTWARE PROGRAMMING OF ELECTRONIC COMPONENTS

PS6.1 Hardware requirements

(a) Where software programming of electronic components (i.e. PLC, radio equipment, telemetry units etc.) are necessary, the contractor shall supply, deliver and configure one computer (notebook) with all peripherals needed for programming of electronic components.

(b) The contractor shall ensure that the supplied hardware is 100% compatible with the supplied software. The minimum requirements are detailed in the detail specification.

PS6.2 Software requirements

(a) System design

(i) The system shall make use of a well-defined, standard, tested, debugged and field-proven operating system to control other programme modules which handle the user functional requirements. The operating system shall be capable of handling all input-output organisation, scheduling, time-keeping, power failure procedures and to control communication with field hardware and operator devices, process system outputs and command requests.

(ii) The operating system shall initialise software upon restart conditions and allocate memory usage of application programmes. Furthermore, the operating system shall enable the system operator to create, store and run application and user programmes while the operating system is busy controlling the real time application system. The user programme modifying facility should be menu driven under operating system control to enable operators to easily effect user system changes.

(iii) Asynchronous events in the real-time application environment shall be suitably handled by the operating system by means of programmed and event-controlled interrupts, organised in priority queues. Suitable precautions shall be taken to ensure that no input, such as an alarm, is lost or indefinitely suppressed because of low priority.

(b) Test programmes

(i) A full set of test and diagnostic programmes shall be supplied as part of this Contract which will enable the Employer's staff to test all computer system components as well as to run and debug programmes.

(ii) An application test programme shall also be supplied, under the control of which system maintenance and commissioning can be performed. This shall include communicating with and controlling of out-stations or remote terminals as applicable.

(c) Documentation

(i) The successful Tenderer shall supply full software documentation within two months from final commissioning of the system.

(ii) Three copies of each of the following shall be provided:

(iii) A programmer's manual on all programming languages used, in English.

(iv) A detailed manual on all compilers or interpreters used, as applicable.

(v) A detailed manual on the assembler.

(vi) A system manual containing detailed description of the operation system and the drivers of each software module, task or sub-module used. The description shall clearly specify the functions and structure of each module and the interfaces and links between them. This manual shall also describe how new software modules can be added, running under the same operating system.

(vii) A manual containing a complete set of programme listings.

(viii) An operator's manual, specifying all the system operating procedures in detail, for each system forming part of this Contract.

(ix) A software user's manual (for each system) providing detailed information on how additions to the system can be generated, for instance the addition of an out-station, creation of a new access control category etc., or how system parameters can be changed or deleted. This manual should avoid the use of computer system jargon, shall include a definition of terms used and shall be written in such a way that operators without formal computer hardware or software training will be able to effect the changes as far as possible.

(x) A testing procedures manual for running all test programmes specified in paragraph 6.6.2 (b) above, describing procedures, results to be expected and remedial action to be taken in case of faults.

(d) Data base compilation and building

(i) The successful Tenderer shall create, edit debug and put into operation the initial database required for each system to be supplied in terms of this document. The database shall be compiled and built from the specified parameters and from information which will be supplied by the Engineer where applicable.

(ii) Tenderers are, therefore, required to allow for the compilation of the required databases in their Tenders, as well as for the provision of a data base modification/service programme.

PS7 MEASUREMENT AND PAYMENT

Item		Unit
PS7.1	Programming hardware	Lump Sum

The unit of measurement shall be a lump sum.

The tendered rate shall include full compensation for the supply, delivery, configuration, debugging and testing of all programming hardware (notebook, etc.) necessary to configure programmable electronic components.

Item		Unit
PS7.2	Electromagnetic compatibility	Prov Sum

No separate payment will be scheduled to ensure electromagnetic compatibility. The rates tendered for equipment shall include all costs associated with the measures specified to ensure electromagnetic compatibility.

ANNEXURE D:

INFORMATION AND COMMUNICATION TECHNOLOGIES SPECIFICATIONS

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CITY OF CAPE TOWN

TRANSPORT ROADS & STORMWATER

CONTRACT NO. 24G/2009/10

DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING, AND COMMISSIONING OF THE IRT FARE SYSTEM, THE SUPPLY AND DISTRIBUTION OF FARE CARDS, AND THE PROVISION OF MAINTENANCE AND OTHER RELATED SERVICES

SCOPE OF WORKS

ANNEXURE D: INFORMATION AND COMMUNICATION TECHNOLOGIES SPECIFICATIONS

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PS1 SCOPE

This specification covers the requirements for all Information and Communication Technology systems.

The scope includes the design, development, supply, delivery, installation, testing and commissioning of computer-based information systems, particularly software applications, computer hardware, and network communication hardware and software, and the cabling thereof. The Information and Communication Technology (ICT) scope deals with the use of electronic computers and computer software to convert, store, protect, process, transmit, and securely retrieve information within the scope of this project.

PS2 STANDARDS

PS2.1 National and International Standards, Publications and Codes

All material/equipment shall comply with the relevant current SABS, BSI and/or IEC standards.

The latest edition at time of tender of the following National and international Standard, Publication and Codes shall be read in conjunction with these specifications. Materials and work specified herein shall comply with:

(a) TIA/EIA-310-D : Cabinets, Racks, Panels, and Associated Equipment

(b) TIA/EIA-568-B : Commercial Building Telecommunications Cabling Standard

(c) TIA/EIA-569-B : Commercial Building Standards For Telecommunications Pathways And Spaces

(d) TIA/EIA-606-A : Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

(e) ISO/IEC 9075 : IT - Database languages -- SQL

(f) SANS/ISO/IEC 11801 : IT - Generic cabling for customer premises

(g) ISO/IEC 14763 : IT - Implementation and Operation of Customer Premises Cabling

(h) ISO/IEC 14882 : Programming languages – C++

(i) ISO/IEC 15018 : IT - Generic cabling for homes

(j) ISO/IEC 17799 : IT - Code of practice for information security management

(k) ISO/IEC 18010 : IT - Pathways and spaces for customer premises cabling

(l) ISO/IEC 23270 : Programming languages -- C#

(m) ISO/IEC 23271 : Common Language Infrastructure (CLI) Partitions I to VI

(n) ISO/IEC 26300 : OASIS Open Document Format for Office Applications

(o) ISO/IEC 27001 : IT - Information security management systems - Requirements

(p) ISO/IEC 29500 : Office Open XML file formats

(q) ISO/IEC 32000 : Portable document format -- PDF 1.7

(r) IEEE 802.1 : LAN/MAN Network Management

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(s) IEEE 802.3 : Ethernet LAN

(t) IEEE 802.11 : Wireless LAN & Mesh

(u) National Minimum Interoperability Standards (MIOS) for Information Systems in Government

(v) National Electronic Communications and Transactions Act 25 of 2002

(w) National Electronic Communications Act 36 of 2005

(x) National State Information Technology Agency Act 88 of 1998

This document is not a substitute for any code, standard or regulation. The Approved Contractor must be aware of local codes that may impact the bid submittal or execution of the project. The current revision of any applicable code, standard, or regulation shall take precedence at the point of project execution, unless otherwise recognized by local authorities. Applicable standards or codes that affect construction, which are listed as normative references within any governing document, are also the responsibility of the Approved Contractor for compliance.

PS3 DEFINITIONS AND ABBREVIATIONS

PS3.1 Definitions

For the purposes of this standard the definitions of ISO/IEC 11801, ISO/IEC 802.3, and ISO/IEC 802.11 apply in addition to the following ones:

a) **identifier** (of component in the information technology infrastructure)
a unique item of information that enables a specific component of the information technology infrastructure to be differentiated in the administration records

b) **label**
a label is used to clearly mark a specific component of the information technology infrastructure with its identifier and (optionally) other information

c) **pathway**
cable route (e.g., conduit, ductwork, cable tray, or tube) used to accommodate cables between termination points defined by a physical structure

d) **record**
collection of information about or related to a specific element of the information technology infrastructure

e) **space**
area (e.g., closet, cabinet, manhole, external enclosure, or server / equipment room) used to house cable terminations or equipment

f) **work order**
collection of information which documents the changes requested and the operations to be carried out on the information technology infrastructure

g) **work area outlets**
collection of connectors, faceplates, boxes and surface housings that allows connectivity of the same cable type between termination points

h) **operating system**
an operating system is a set of computer programs that manage the hardware and software resources of a computer

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i) **server**
a server is a powerful processing computer system that provides services to other computer systems--called clients--over a computer network, the term server can refer to hardware or software

j) **man machine interface**
is the aggregate of means by which people—the users—interact with the computer system—a particular machine, device, computer program or other complex tools. The user interface provides means of Input (allowing the users to manipulate a system), and Output (allowing the system to produce the effects of the users' manipulation). Can also be referred to as “user interface”

k) **network topology**
is the study of the arrangement or mapping of the elements (links, nodes, etc.) of a network, especially the physical (real) and logical (virtual) interconnections between nodes

l) **star network topology**
A star topology connects all cables to a central point of concentration. This point is usually a switch. Nodes communicate across the network by passing data through the switch.

m) **tree network topology**
A Tree Network consists of star-configured nodes connected to switches/concentrators, each connected to a linear bus backbone. A tree topology (also known as hierarchical topology) can be viewed as a collection of star networks arranged in a hierarchy. This tree has individual peripheral nodes (e.g. leaves) which are required to transmit to and receive from one other node only and are not required to act as repeaters or regenerators. Unlike the star network, the functionality of the central node may be distributed.

n) **network overhead**
Framing, error control, addressing, idle code, or any other characters or bit sequences in a data transmission other than actual end-user data.

o) **on-board**
Located on a circuit board. Often refers to components or devices that are usually connected to the computer through expansion slots or ports, which are integrated onto the motherboard such as video adapters, sound cards or network cards. (eg a motherboard that has integrated video can be said to have Video On-board).

p) **motherboard**
The main printed circuit board in a computer that carries the system buses. It is equipped with sockets to which all processors, memory modules, plug-in cards, daughter boards, or peripheral devices are connected.

q) **kvm switch**
is a hardware device that allows a user to control multiple computers from a single keyboard, video monitor and mouse.

r) thin client
is a network computer without a user writable long term storage device, which, in client/server applications, is designed to be especially small so that the bulk of the data processing occurs on the server.

s) malware
“Malicious software”; a generic term covering a range of software programs and types of programs designed to attack, degrade or prevent the intended use of an ICT or network. Types of malware can include viruses, worms, Trojans, malicious active content and denial of service attacks. In the case of invasion of privacy for the purposes of fraud or the theft of identity, software that passively observes the use of a computer is also malware (“spyware”).

t) software engineering
is the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software.

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u) intrusion detection system
An intrusion detection system is used to detect several types of malicious behaviours that can compromise the security and trust of a computer system. This includes network attacks against vulnerable services, data driven attacks on applications, host based attacks such as privilege escalation, unauthorized logins and access to sensitive files, and malware (viruses, trojan horses, and worms).

v) **message-oriented middleware**
Message-oriented middleware is a client/server infrastructure that increases the interoperability, portability, and flexibility of an application by allowing the application to be distributed over multiple heterogeneous platforms. It reduces the complexity of developing applications that span multiple operating systems and network protocols by insulating the application developer from the details of the various operating system and network interfaces. APIs that extend across diverse platforms and networks are typically provided by the MOM. MOM is software that resides in both portions of client/server architecture and typically supports asynchronous calls between the client and server applications. Message queues provide temporary storage when the destination program is busy or not connected. MOM reduces the involvement of application developers with the complexity of the master-slave nature of the client/server mechanism.

w) **firmware**
The combination of a hardware device and computer instructions and data that reside as read-only software on that device. Within the context of this document the firmware definition will be extended to the Programmable ROM chips that can be upgraded during its lifecycle.

PS3.2 Abbreviations

CAD	Computer Aided Design
HVAC	Heating, Ventilation, Air conditioning
PABX	Private Automatic Branch Exchange
COTS	Commercial Off the Shelf
ADSL	Asymmetric Digital Subscriber Line
POTS	Plain Old Telephone System
MUTOA	Multi-User Telecommunications Outlet Assembly
UTP	Unshielded Twisted Pair
TVSS	Transient Voltage Surge Suppressors
RAID	Redundant Array of Inexpensive Disks
SATA	Serial Advanced Technology Attachment
NCQ	Native Command Queuing
DVD	Digital Versatile Disc
CD	Compact Disc
USB	Universal Serial Bus
SMART	Self-Monitoring, Analysis and Reporting Technology
MTBF	Mean Time Between Failures
DDR	Double Data Rate

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RAM	Random Access Memory
UPS	Uninterruptable Power Supply
PE	Project Engineer
SXGA	Super Extended Graphics Array
OpenGL	Open Graphics Library
NIC	Network Interface Card
FSB	Front Side Bus
SDRAM	Synchronous Dynamic Random Access Memory
SAN	Storage Area Network
PAE	Physical Address Extension
LTO	Linear Tape-Open
SAS	Serial Attached SCSI
ECC	Error Correcting Code
KVM	Keyboard, Video, and Mouse
LCD	Liquid Crystal Display
SQL	Structured Query Language
DNS	Domain Name Service
DHCP	Dynamic Host Configuration Protocol
LDAP	Lightweight Directory Access Protocol
SMB	Server Message Block
NTP	Network Time Protocol
DPI	Dots Per Inch
API	Application Programming Interface
MOM	Message-Oriented Middleware

PS4 NETWORK CABLING

All copper-based Ethernet communications cable shall be augmented Category 6 UTP rated for 500MHz for 10 Gigabit Ethernet connections, and augmented Category 5e UTP rated for 100MHz for 1 Gigabit Ethernet or lower connections.

PS4.1 General

1) Cable pathways, including conduit, cable tray, ladder, rack, raceway, slots, sleeves, etc. shall be located and mounted according to contract drawings and manufacturer's instructions. Pathways shall not be installed in wet areas.

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2) Cable pathway fill ratio, bend radius, run length, number of bends, and proximity to EMI sources shall be in accordance with ANSI/TIA/EIA-569-B. Maximum fibre/core count of the initial installation shall not exceed 40% fill ratio in any pathway.

3) In accordance with SABS, power wiring and communications cabling shall not share the same pathway or outlet unless separated by a physical barrier.

4) Cable pathways shall be secured to a structural member of the building, or permanent wall studs. Wall surfaces for raceway mounting should be finished complete.

5) Metallic pathways shall be electrically continuous, free of sharp edges, and properly bonded to an approved ground. Cableway bonding shall comprise insulated 4 sqmm pvc-insulated earth cable. EMI sources such as ballasts, motors, and bus conductors shall be avoided by using proper separation distances.

6) Pathways that penetrate fire-rated barriers shall be fire stopped according to local codes and recognized practices. Fire stop materials or devices shall be qualified to UL-1479, in accordance with ASTM E814. Fire stop method shall have PE approval.

7) Core drilling of holes for fire-rated outlet devices shall have approval by a structural engineer or PE on the contract drawings prior to start of work.

8) Pathways for vertical cable runs, such as slots and sleeves, shall be installed in the proper location in accordance with applicable codes and standards.

9) Installed augmented category 6 and category 5e balanced UTP, pathways and distribution facilities shall adhere to manufacturer's instructions, contract drawings and specifications, and applicable codes, standards and regulations.

10) Following installation, the cable infrastructure shall be tested and certified by a certified Agency, eg Krone, Modtap, etc

11) Installed augmented category 6 and category 5e balanced UTP cabling systems and field test results shall strictly adhere to requirements of ANSI/TIA/EIA-568-B.

12) Where applicable, all equipment, components, accessories and hardware shall be UL listed for the intended purpose of the installation.

13) Installed products shall be manufactured by an ISO 9001 certified facility.

14) Installed products shall be free from defects in material or workmanship from the manufacturer, and shall be of the quality indicated.

15) All methods of construction that are not specified in the contract documents shall be subject to control and approval by the Client or Client's Representative.

16) Installed products shall be lot-traceable by date code.

17) All critical internal manufacturing operations for installed products shall have documented in-process inspection and testing according to ISO9001.

18) Where "approved equal" is stated, any substitute product shall be equivalent to all requirements specified or referenced in this document, and is subject to approval by the Client or Client's Representative.

19) Redundancy communication links between nodes shall not be within the same pathway.

20) Redundancy communication links shall not be within 50cm proximity of the main communication link for more than 1m, unless within a cabinet, rack, or wiring closet. The contractor needs written approval from the PE if he/she requires leniency due to physical constraints.

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PS4.2 Pathways

1) All pathways shall strictly adhere to the requirements of ANSI/TIA/EIA-569-B.

2) Non-conductive pathways shall be utilised as far as possible.

3) All cable routes shall utilize pathways (cable routes inside floor or ceiling plenums shall also be pre-planned)

4) Non-metallic raceway shall be an extruded one-piece construction with hinged cover, or two-piece construction having a base and cover, with a full assortment of fittings, outlet boxes, faceplates and accessories. Raceway shall be sized appropriately to accept full cable capacity at 40% fill ratio.

5) Metal trunking/raceway shall be a roll-formed and painted two-piece construction, having a base and cover, with a full assortment of fittings, outlet boxes, faceplates and accessories. Raceway shall be sized appropriately to accept full cable capacity at 40% fill ratio.

6) Ladders shall be a welded and powder coated construction of galvanized steel in various lengths and widths, with a full assortment of elbow fittings and mounting, splicing, and cable drop bend radius hardware.

7) Conduit, cable tray, J-hooks and other cable support structures, including pull-boxes, distribution ducts, cellular floors, etc. shall be of specific design, quality and capacity indicated in the contract documents. Choice of supplier may be the discretion of the contractor unless otherwise indicated.

PS4.3 Work Area Data Outlets

1) Augmented category 6 and category 5e modular jacks shall be standard RJ-45 receptacle, with keystone snap mounting features.

2) Augmented category 6 and category 5e modular jacks, when installed, shall exceed the link or channel performance requirements of ANSI/TIA/EIA-568-B. Jacks installed into modular faceplates, regardless of configuration, shall also meet the alien crosstalk performance of ANSI/TIA/EIA-568-B.

3) Work area outlet faceplates and frames shall be available in 1-gang and 2-gang sizes, with various modular designs and standard colours in compliance with user-specified arrangements, including the following configurations:

   a. 106 Duplex, Angled, Front loading, Furniture, Rear loading, Style Line, Tamper-resistant, NEMA 3R Weatherproof, Stainless Steel, and Special models.

4) Work area Surface Mount Housings shall be a two-piece base and cover design, available in various port capacities, including 1- and 2-port, 4-port, 6-port and 12-port.

5) Work area MUTOA housings shall be available in various modular designs in compliance with user-specified modular connector arrangements.

6) Recessed Wall Boxes shall provide multi-service modular power and data options for in-wall applications.

7) Recessed wall boxes 100mm or larger shall have at least one 25mm. conduit knockout to provide 12-port capacity with augmented Category 6 / Category 5e cable.

8) Raceway outlet boxes shall be available in standard sizes and capacities for all raceway sizes, including metallic or non-metallic raceway.

9) Faceplates for raceway outlet boxes shall accept modular jacks and connectors in various user-specified arrangements.

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10) Work area fire-rated receptacles shall be rated for scrub water exclusion, and be available in various modular power and data configurations in compliance with user-specified arrangements.

11) Consolidation point enclosures used in horizontal cable runs, using wall-mount, in-floor, or ceiling-mount installation shall be designed and UL listed specifically for the intended purpose.

12) Wall outlet and cable drop pathway location shall be according to contract drawings. Guidelines from ANSI/TIA/EIA-569-B should be followed for location with electrical outlets and outlet height above finished floor.

13) Outlet boxes shall be fastened securely to a wall stud or structural element, in a manner to permit flush mounting of the faceplate with the finished wall.

14) Multi-connect boxes shall be installed in a manner to comply with separation rules for power and communications wiring in close proximity.

15) Refer to specific manufacturer's recommendations for wall outlet selection, cable deployment, and termination of jacks into faceplates. Due to the larger size of augmented category 6 cables, extra outlet box depth is required to allow for proper cable bend radius when the faceplate is installed. Certain restrictions may apply when installing augmented category 6 cabling.

16) Raceway or conduit should be deployed to the surface housing location. For through-wall cable entry, cut the wall opening to match the opening in the housing base.

17) Lay out mounting holes onto the desired wall location. For masonry or concrete walls, drill to the proper depth and install anchors.

18) Always use proper wall anchors. Installing mounting screws directly into partition board without using anchors can cause screw pullout and detachment of the surface housing. Mounting the base plate to studs is recommended.

19) Mount base plate of surface box or MUTOA to outlet location using proper fasteners. Note: furniture and wall outlet applications require mounting of base plate prior to cable pulling and connector termination.

20) Install cover onto base plate.

21) Refer to detailed manufacturer's guidelines for cable deployment and termination of jacks into surface housings. Due to the larger size of augmented category 6 cables, proper cable bend radius must be maintained. Certain restrictions may apply when dressing augmented category 6 cabling into surface housings.

22) Terminate jacks according to manufacturer's instructions.

23) To assure 10GBase-T performance, maintain wiring pair twists as close as possible to the point of termination. Also minimize the length of exposed pairs from the jacket to the IDC termination point during installation.

24) The length of wiring pair un-twist in each termination shall be less than 13 mm.

25) Jacks shall be properly mounted in plates, frames, or housings with stuffer cap fully installed over IDC contacts.

26) Horizontal cables extending from mounted jacks shall maintain a minimum bend radius of at least 4 times the cable diameter, unless space is restricted. Note: Refer to specific manufacturer's recommendations for restricted cable bend radius, especially with regard to augmented Category 6 cables.

27) Cable terminations shall minimize tensile or bending strain on IDC contacts after assembly of faceplate or housing to the wall outlet. See note below.

28) Mount 6-110 wiring blocks in the desired location.

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29) Route cables through the openings in the wiring block base.

30) Terminate UTP cables to the 6-110 block according to manufacturer's instructions, using the connecting blocks and proper termination tool.

31) To maximize transmission performance, maintain wiring pair twists as close as possible to the point of termination.

32) The length of wiring pair un-twist in each termination shall be less than 13 mm.

33) Cables extending from the block terminations shall maintain a minimum bend radius of at least 4 times the cable diameter.

34) Cable terminations shall have minimal tensile or bending strain on IDC contacts after termination. Note: Use the appropriate cable management hardware to relieve cable strain and to control bend radius.

PS4.4 Cable

1) Augmented category 6 and category 5e horizontal cable shall be 4-pair, balanced unshielded twisted pair (UTP), available in 500m reels of plenum or riser versions, in various colours.

2) Augmented category 6 and category 5e UTP cable, from the manufacturer, shall exceed all electrical requirements, including alien crosstalk performance requirements of ANSI/TIA/EIA-568-B.

3) Augmented category 6 and category 5e distribution cable, when installed and terminated, shall exceed the link or channel performance requirements of ANSI/TIA/EIA-568-B.

4) Augmented Category 6 and category 5e patch cords shall be constructed with stranded UTP cable with a smoke colour polycarbonate RJ-45 type plug on each end with integral snag-proof strain relief boot. Patch cords shall be suitable for use with workstations, horizontal and backbone cross-connect, main cross-connect and equipment cords.

5) Augmented category 6 and category 5e patch cords, when installed in a channel system, shall exceed the performance requirements of ANSI/TIA/EIA-568-B.

6) Refer to detailed manufacturer's guidelines for deployment of augmented category 6 and category 5e cable. Certain restrictions apply, and specific techniques are recommended. Tight bundling of augmented category 6 and category 5e cables over long lengths should be avoided to minimize alien crosstalk between cables.

7) Using approved methods, pull cable into conduit, or place into raceway or cable tray as specified. Do not exceed 10kg pull per cable. Use appropriate lubricants as required to reduce pulling friction. Avoid kinking and twisting of cables during installation.

8) Exposed cabling shall be installed in surface raceway.

9) Cables above ceilings or below access floors shall be installed in cable tray or open-top cable hangers.

10) Cable slack and service coils shall be stored properly above the ceiling or under the access floor. A "figure-eight" service loop is recommended for augmented category 6 cabling to reduce EMI coupling. Loose, random bundling is recommended.

11) Pathway fill ratio in conduit, tray, raceway, etc. shall not exceed 40% of pathway cross-sectional area. Do not overfill cable pathways or supports. Oversized supports are recommended to keep cable bundles loose and random.

12) Installed cable bend radius shall be greater than 4 times cable diameter. Avoid kinking or twisting the cable during installation.

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13) Do not over-tighten tie-wraps around cable bundles. Do not use staples or clamps to anchor cables.

14) Keep bundles loose and random. Velcro straps are recommended to avoid tight packing of cable bundles.

15) Recommended spacing of cable supports above the ceiling is 1.5m. Maximum allowed spacing is 1.8m.

16) Maintain the following minimum clearances from EMI sources:

    a. Power cable in parallel: 300mm.

    b. Power cable intersections: 150mm

    c. Florescent lights: 300mm

    d. Transformers and electrical service enclosures: 900mm

    e. Bus conductors or high-current branch circuits: 3m.

17) Communications cabling that must cross power cables or conduit shall cross at a 90-degree angle, and shall not make physical contact.

18) Length of horizontal cable runs from the Telecommunications Room (Server Room) to each wall outlet shall not exceed 90 meters. Length of backbone cable runs from the equipment room to each Telecommunications Room shall not exceed 90 meters.

19) Leave sufficient slack for 90 degree sweeps at all vertical drops.

20) Do not install cable in wet areas, or in proximity to hot water pipes or boilers.

21) Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations.

22) Installed cable jackets shall have no abrasions with exposed conductor insulation or bare copper ("shiners"). The installer is responsible to replace damaged cables.

23) Backbone cables shall be installed and bundled separately from horizontal distribution cables. Backbone and horizontal cable bundles shall be loose and random.

24) Vertical runs of backbone cables shall be supported with messenger strand, cable ladder, or other recognized means to properly support the weight of the cable.

25) Backbone cables spanning more than three floors shall be supported at the top of the cable run with a wire mesh grip and on alternating floors, unless otherwise specified by local codes or manufacturer's guidelines.

26) Vertical runs of backbone cables entering each Telecommunications Room shall be securely fastened along a properly prepared wall in the Telecommunications Room on each floor. Use of cable ladder is recommended.

27) Cable transitions from vertical to horizontal orientation and cable entry into racks and cabinets shall maintain proper cable bend radius.

28) Firestop all cables and pathways that penetrate fire-rated barriers using approved methods and according to local codes.

29) Patch cord lengths should match the distance between connection points, with enough slack for cable management and bend radius control.

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30) The recommended Manufacturers hauling tension shall not be exceeded at any stage during or after installation.

31) All cable shall be plenum rated cable.

PS4.4 Cable labelling

PS5 COMMUNICATION HARDWARE

PS5.1 General

1) Network equipment (Switches, Routers, Media Converters, Gateways, etc.) shall adhere to manufacturer's instructions, contract drawings and specifications, and applicable codes, standards and regulations.

2) No "hubs" shall be allowed, only "switches".

3) All network transmission equipment shall either be "Transition", "Linksys", "Hewlett – Packard", "3Com", "Nortel Networks", or "Cisco".

4) Where applicable, all equipment, components, accessories and hardware shall be Underwriters Laboratories (UL) listed for the intended purpose of the installation.

5) Installed products shall be manufactured by an ISO 9001 certified facility.

6) Installed products shall be free from defects in material or workmanship from the manufacturer, and shall be of the quality indicated.

7) Installed products shall be lot-traceable by date code.

8) All critical internal manufacturing operations for installed products shall have documented in-process inspection and testing according to ISO9001.

9) Where "approved equal" is stated, any substitute product shall be equivalent to all requirements specified or referenced in this document, and is subject to approval by the Client or Client's Representative.

10) It shall be the contractor's responsibility to utilize the supplied hardware's redundancy capabilities within the Network Topology specified.

11) All network transmission equipment shall adhere to the Rapid Spanning Tree Protocol (RSTP) as specified by the IEEE 802.1 standard and be of the "Managed" configuration kind.

12) All network transmission equipment shall be Rack-mountable, either through its own form-factor, or through mounting equipment that the contractor shall supply.

PS5.2 Network Topology

1) The network topology that shall be adhered to is the Tree Topology.

2) The network shall be divided into three layers:

    1) Root Layer with default 10GBASE (Full duplex) connections, backwards compatible to 1000BASE (Full duplex), as specified by the IEEE 802.3 standard. No 100BASE connections as specified by the IEEE 802.3 shall be connected to this layer. Server hardware will be connected on this Layer. If there is only one connection from the Middle Layer to the Root Layer, the default connections can be rated at 1000BASE (Full duplex).

    2) Middle Layer with default 1000BASE (Full duplex) connections, backwards compatible to 100BASE (Full duplex), as specified by the IEEE 802.3 standard. Each switch within this

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layer shall provide one (1) uplink connection of 10GBASE to the Root Layer. This layer is primarily for concentration of network traffic but may allow for the connection of Workstations. Redundancy connections shall be made between network equipment within this layer.

3) Bottom Layer with default 100BASE (Full duplex) connections, backwards compatible to 10BASE (Full duplex), as specified by the IEEE 802.3 standard. Each switch within this layer shall provide one (1) uplink connection of 1000BASE to the Middle Layer. Node equipment (Terminals, Printers, Media Converters, Programmable Automation Controllers, etc.) shall be connected to this layer. Redundancy connections shall be made between network equipment within this layer.

3) The network shall be segmented through a Managed Layer 3 Switch at the Root Layer if the Root Layer's switch's connection reaches the 70% capacity utilization mark or if it reaches the 50% available bandwidth mark. These segments shall adhere to the Network Bandwidth requirements, if these requirements are exceeded the segments shall be re-segmented. These segment connections shall be 10GBASE (Full duplex) based.

4) Inter-Building connections shall be Fibre Optic cable based communications. (See the Fibre Optic Standard within the Standard Specifications).

5) Intra-Building connections shall be augmented Category 6 UTP cable.

PS5.3 Network Bandwidth

1) Up to 70% of a single switch/hub/concentrator/patch panel' ports shall be utilized.

2) Only 50% of the specified maximum bandwidth indicated by the corresponding IEEE 802.3 standard (e.g. 10BASE's maximum bandwidth is 10 Mbit/s) shall be considered as available bandwidth (e.g. 10BASE's available bandwidth shall be derated to 5 Mbit/s or 625Kb/s) from any network equipment. The remaining bandwidth shall be considered as network overhead.

3) It shall be the contractor's responsibility to ensure that he/she tender for the correct amount of network hardware to ensure the Network Topology and Network Bandwidth requirements.

PS5.4 Network Configuration

1) The managed network equipment shall be configured by a qualified network technician approved by the manufacturer.

2) Each network segment shall be in its own Subnet.

3) All unused ports shall be closed.

4) Each network segment shall have its own Domain Controller. For more than one segment, the segments' Domain Controller shall become a Backup Domain Controller. There shall only be one Primary Domain Controller.

5) It shall be the responsibility of the contractor to supply a fully working Network Infrastructure that adheres to the requirements.

6) A certificate shall be issued from the manufacturer indicating that the installation and configuration has been done in accordance with their requirements. It is the responsibility of the contractor to obtain this certification.

PS6 SERVER HARDWARE

PS6.1 General

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1) Server hardware shall adhere to manufacturer's instructions, contract drawings and specifications, and applicable codes, standards and regulations.

2) All Server hardware shall either be "Dell", "IBM", "Hewlett – Packard", or "Fujitsu-Siemens".

3) Installed products shall be manufactured by an ISO 9001 certified facility.

4) All server hardware shall be supplied with a 3 Year "Next Business Day On-SIte" warranty. If for some reason the manufacturer does not service the particular area, the contractor needs to negotiate and supply an alternative solution.

5) All server hardware shall be installed and configured according to the manufacturer's specifications within the manufacturer specified rack.

6) All server hardware form factor shall be that of a 19" rack mount option.

PS6.2 Processing

1) All processors shall have a minimum of two cores per physical processor.

2) All processors shall be a minimum of 32-Bit.

3) On 32-Bit X86 Architecture processors, the processor shall be PAE compliant.

4) All processors shall have a minimum of 64KB per Core of Level 1 Cache.

5) All processors shall have a minimum of 2MB of Level 2 Cache, with the exception of the Cell Broadband Engine architecture with a minimum of 512KB.

6) All processors' manufacturing date shall not be older than 2 years when delivered.

7) All processors shall either be "Intel", "AMD", or "STI" ("Sony Computer Entertainment", "Toshiba Corporation", and "IBM").

8) All processor architectures shall either be "X86", "X86-64", or "Cell Broadband Engine" as a minimum.

9) It is the responsibility of the contractor to ensure that the Server's motherboard is compliant to all the requirements.

PS6.3 Storage

1) All Hard drives shall have the SATA 3 Gbit/s interface as describe by the Serial ATA International Organization.

2) All Hard drives capacities shall be of the same size. (RAID and management requirement).

3) A minimum of two (2) hard drives shall be used.

4) All Hard drives shall have the NCQ technology.

5) All Hard drives shall have the SMART technology.

6) All Hard drives shall have a minimum MTBF of 1,000,000 hours.

7) Only Server manufacturer approved hard drives shall be used.

8) Hardware RAID 1 configurations shall be utilized as a minimum to achieve the desired capacities as specified in the "Scope of Works". No software RAID configurations shall be allowed.

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9) Hardware RAID 5 configurations shall be utilized to achieve the desired capacities as specified in the “Scope of Works” if more than 2 hard drives are used. If the Server have been identified as a “Mission Critical Server” RAID 6 shall be used instead. No software RAID configurations shall be allowed.

10) All RAID configurations shall have a minimum of two (2) partitions. One for the operating system, and programs, the other for data. It is the responsibility of the contractor to ensure that the sizes of the partitions are appropriately configured.

11) RAID Controller’s interface shall be that of PCI-Express.

12) All the Servers will have DVD Writers installed that are able to read/write to/from the following formats: DVD+R, DVD-R Dual Layer, CD-R, DVD-RAM, DVD-RW, DVD-R, CD-RW, DVD+R Double Layer, DVD+RW.

13) A minimum of one (1) Server shall include a Blueray writer.

14) It is the responsibility of the contractor to ensure that the Server’s motherboard is compliant to all the requirements.

15) It is the responsibility of the contractor to ensure that the storage requirements are met and provided for.

PS6.4 Interfaces

1) All servers shall have a minimum of two (2) USB 2.0 ports.

2) All servers shall have two (2) PS2 connectors. One for they keyboard, another for a mouse.

3) All servers shall have a minimum of one (1) VGA DE15 Female connector for video output. The video processing abilities of the servers shall include:

    1) A minimum of SXGA compliant resolution output.

    2) The video chipset shall be DirectX 9c compliant as defined by Microsoft.

    3) The video chipset shall be OpenGL 2.1 compliant as define by the Kronos Group.

    4) The video memory shall be a minimum of 8MB of memory.

    5) The Graphics Processing Unit shall strictly either be “Intel”, “AMD/ATI”, or “nVidia”.

    6) On-board video controllers shall exceed these requirements.

4) All servers shall have a minimum of one (1) Ethernet RJ45 Female connector. The network processing abilities of the servers shall include:

    1) The NIC shall be a 10GBASE-T (Full Duplex) one.

    2) The NIC shall strictly either be “Intel”, “AMD”, “Cisco”, “Linksys”, “SMC”, ”D-Link”, “Netgear”, “National Semiconductor”, “IBM”, “HP”, “Transition”, or “3Com”

    3) The NIC interface to the host system shall be that of PCI Express.

5) It is the responsibility of the contractor to ensure that the Server’s motherboard is compliant to all the requirements.

PS6.5 Memory

1) DDR 2 Registered ECC Ram shall be used as a minimum standard.

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2) A minimum total of 2GB of DDR 2 ECC RAM shall be used.

3) Only server manufacturer approved memory shall be used.

4) Memory shall strictly be the same frequency rated as the FSB.

5) A dual channel configuration shall be used. Memory shall be divided into the amount of channels available, and installed as such. (e.g. for a 2GB configuration, with 2 channels, two (2) 1GB memory modules shall be installed).

6) It is the responsibility of the contractor to ensure that the Server's motherboard is compliant to all the requirements.

PS6.6 Installation

1) It is the responsibility of the contractor to mount the server according to manufacturers' specifications.

PS6.7 Specialized Storage

1) If the storage requirements of a single Server exceeds 10TB of data storage space. The contractor shall be required to provide a SAN solution. The SAN shall adhere to the following:

    1) The SAN hardware / software shall adhere to manufacturer's instructions, contract drawings and specifications, and applicable codes, standards and regulations.

    2) The minimum specification of the hard drives will stand if the manufacturer's specifications do not contradict these specifications.

    3) The SAN shall fit in 19" rack cabinets. Multiple cabinets should be provided by the contractor if the SAN manufacturers' specification requires it.

    4) The SAN shall allow for a minimum expansion of 80TB within its internal storage capacity.

    5) The SAN shall allow for a minimum expansion of 4PB within external storage capacity.

    6) The SAN shall be configured for RAID 5 usage. If the SAN have been identified as a "Mission Critical SAN" RAID 6 shall be used instead.

    7) The SAN shall have a minimum of 4Gbit Fibre Channel interfaces to the Servers. It is the contractor's responsibility to ensure that the Servers have the corresponding interface cards and meet the corresponding requirements. The interface cards shall be of PCI Express interface on the Servers.

    8) The SAN shall have a minimum of two (2) iSCSI interfaces rated at a minimum of 1Gbit.

    9) The SAN shall have 40% more Fibre Channel connections as per requirement.

    10) All SAN solutions shall either be "HP", "Sun Microsystems", "IBM", "Compellent", "EMC", "Fujitsu Siemens", "Dell", or "NetApp"

    11) It is the responsibility of the contractor to ensure that the SAN is compliant to all the requirements.

2) If a backup server has been requested, the backup server shall include a magnetic tape data storage technology of type LTO. The LTO shall adhere to the following:

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1) The LTO hardware / software shall adhere to manufacturer's instructions, contract drawings and specifications, and applicable codes, standards and regulations.

2) All LTO equipment shall be Rack-mountable, either through its own form-factor (19"), or through mounting equipment that the contractor shall supply.

3) The LTO media shall have a minimum capacity of 800GB uncompressed data.

4) The LTO technology shall be based upon the LTO-4 standard as a minimum.

5) The standard form-factor of LTO media shall be "Ultrium".

6) The interface to the backup server shall either be SAS or iSCSI. It is the contractor's responsibility to ensure that the Servers have the corresponding interface cards and meet the corresponding requirements.

7) All LTO solutions shall either be "IBM", "Hewlett-Packard", "Quantum", "Dell", or "Tandberg Storage".

8) It is the responsibility of the contractor to ensure that the LTO system is compliant to all the requirements.

PS6.8 Specialized Power Supplies

1) If the Server have been identified as a "Mission Critical Server" the Server is required to have a redundant power supply that is hot swappable.

2) It is the responsibility of the contractor to ensure that the Server is compliant to all the requirements.

3) The contractor shall ensure that his equipment is protected against overvoltage. The Client will not entertain claims with regard to damaged power supplies or other equipment if the contractor is unable to prove the existence of Class III overvoltage protection equipment, limiting the downstream impulse level to 1.5kV.

PS7 MAN MACHINE INTERFACE HARDWARE

PS7.1 General

1) Man Machine Interface hardware shall adhere to manufacturer's instructions, contract drawings and specifications, and applicable codes, standards and regulations.

2) All Man Machine Interface hardware shall either be "Dell", "IBM", "Hewlett – Packard", "Microsoft", "LG", "Fujitsu-Siemens", "Lexmark", "Canon", "Epson", "Brother", "Samsung", "AlienWare", "Xworks", or equivalent.

3) Installed products shall be manufactured by an ISO 9001 certified facility.

4) All man machine interface hardware shall be installed and configured according to the manufacturer's specifications at the positions indicated by the PE.

PS7.2 Servers

1) Each 19" cabinet/rack/enclosure that houses more than one Server shall have a KVM switch. The KVM switch shall adhere to the following:

    1) The KVM switch shall allow the input/output of all the servers in that rack as a minimum.

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2) The KVM switch shall allow the input/output of other KVM switches' servers.

3) The KVM switch shall allow the input/output of a USB device.

4) The KVM switch shall allow the input/output of PS2 devices (Mouse/Keyboard).

5) The KVM switch shall be a 19" rack mountable form factor.

6) It is the responsibility of the contractor to supply sufficient KVM switch to Server cables.

7) It is the responsibility of the contractor to ensure that the KVM switch system is compliant to all the requirements.

2) Each 19" cabinet/rack/enclosure that houses one or more Server shall have a rack mountable Rack mountable Keyboard, Video (monitor), and Mouse (KVM). The KVM shall adhere to the following:

1) The KVM shall have as a minimum 15" SVGA LCD display.

2) The KVM shall have as a minimum a full QWERTY keyboard.

3) The KVM shall have as a minimum a 2-button touchpad.

4) The KVM shall have as a minimum one (1) USB port.

5) The KVM shall be a 19" rack mountable form factor that shall not take more than 2 RU space within the rack.

6) It is the responsibility of the contractor to install the KVM in a convenient position within the rack, and that the KVM has access to all servers within the rack.

7) It is the responsibility of the contractor to ensure that the KVM is compliant to all the requirements.

PS7.3 Thin Clients

1) Thin Clients shall have a minimum of 512MB DDR2 SDRAM memory.

2) Thin Clients shall have a minimum of 1 GB Flash RAM memory.

3) At a minimum the Thin Clients shall be able to handle the RDP, ICA, or NX protocols.

4) Thin Clients shall have a minimum of 2 USB 2.0 ports.

5) Thin Clients shall have a minimum of 2 PS2 ports.

6) Thin Clients shall have a minimum of 1 100BASE Ethernet NIC interface.

7) Thin Clients shall be supplied with a cable-based lock, and secured accordingly.

8) Thin Clients shall have a minimum of 1 VGA output for external display. Each Thin client shall have his own external display. The external display shall be a minimum of a 17" Active Matrix LCD display.

9) Each Thin Client shall have a 104-key PC US English QWERTY layout keyboard. The keyboard interface can either be USB or PS2.

10) Each Thin Client shall have an Optical Mouse with a minimum of two (2) buttons and a scroll wheel. The mouse interface can either be USB or PS2.

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11) It is the responsibility of the contractor to ensure that the Thin Clients and their respective peripherals are compliant to all the requirements.

12) It is the responsibility of the contractor to ensure that the Thin Clients and displays are affixed to work areas for security purposes.

13) All cables at the rear of the Thin Client shall be neatly and tightly packed by using Velcro straps.

PS7.4 Workstations

1) Only when a single user's requirements are in the form of CAD or Software Engineering, shall the contractor supply a Workstation class computer instead of a Thin Client.

2) All Workstation requirements shall meet the requirements of the Server requirements with the following requirements superseding those:

    1) Workstations shall have a minimum of 1TB of hard drive capacity in a RAID 5 configuration.

    2) Workstations shall have a minimum of 1 1000BASE Ethernet NIC interface.

    3) Workstations shall be supplied with a cable-based lock, and secured accordingly.

    4) Workstations shall have a minimum of 1 VGA output for external display. Each Workstations client shall have his own external display. The external display shall be a minimum of a 17" Active Matrix LCD display. The Graphics adaptor shall:

        i. Be a CAD approved adaptor.

        ii. Have a minimum of 512MB dedicated ram.

        iii. Have a minimum of DDR2 RAM.

        iv. Be DirectX 9c compliant as defined by Microsoft.

        v. Be OpenGL 2.1 compliant as define by the Kronos Group.

        vi. Either be "nVidia", or "ATI/AMD".

        vii. Be of a PCI Express interface.

3) Each Workstation shall have a 104-key PC US English QWERTY layout keyboard. The keyboard interface can either be USB or PS2.

4) Each Workstation shall have an Optical Mouse with a minimum of two (2) buttons and a scroll wheel. The mouse interface can either be USB or PS2. The mouse shall have a minimum resolution of 800 DPI.

5) It is the responsibility of the contractor to ensure that the Workstations and their respective peripherals are compliant to all the requirements.

6) It is the responsibility of the contractor to ensure that the Workstations and displays are affixed to work areas for security purposes.

7) All cables at the rear of the Workstations shall be neatly and tightly packed by using Velcro straps.

PS7.5 Printers

1) Printers shall be Laser Printers. If the installation requires a Dot Matrix printer specifically, the service requiring the printer's requirements shall be met.

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2) Laser Printers shall be Monochrome based.

3) Printers shall be rated for a minimum of 15,000 pages per month duty cycle.

4) Printers shall be rated for a minimum of 20 pages per minute, single sided, monochrome.

5) Printers shall be able as a minimum hold up to 250 sheets of plain A4 paper.

6) Printers shall be able to do automatic duplex printing.

7) Printers shall have a 100BASE network interface.

8) Printers shall as a minimum be able to handle a resolution of 1200 DPI x 1200 DPI.

9) Printers shall as a minimum be able to simulate PCL 6, PCL 5E, or PostScript 3.

10) Printers shall as a minimum have a USB interface to the host. When a printer is shared between multiple users, such a printer shall be connected directly to the Network via a Network Interface.

11) Printers shall have a minimum of 64MB of memory installed.

12) It is the responsibility of the contractor to ensure that the Printers are compliant to all the requirements.

PS7.6 Scanners

1) Scanners shall be of a “Flatbed” type.

2) Scanners shall have a “Document Feeder/Tray” for multiple documents scanning.

3) Scanners shall have a minimum scan quality of 48Bit in Colour Depth.

4) Scanners shall have a minimum scan quality of 1600 DPI.

5) Scanners shall as a minimum have a USB interface to the host, and be TWAIN compliant.

PS7.7 Consumables

1) It is the responsibility of the contractor to supply the amount of LTO media tapes for backup use specified in the “Scope of Works”.

2) It is the responsibility of the contractor to supply the amount writeable DVD media for backup use specified in the “Scope of Works”.

3) It is the responsibility of the contractor to supply the amount writeable Blue-Ray media for backup use specified in the “Scope of Works”.

4) It is the responsibility of the contractor to supply the amount A4 sized blank white pages specified in the “Scope of Works”

5) It is the responsibility of the contractor to supply each Laser Printer with a manufacturer approved Toner Cartridge.

6) It is the responsibility of the contractor to supply each Dot-Matrix Printer with a manufacturer approved Ink-Ribbon.

PS8 SOFTWARE

PS8.1 General

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1) Software shall adhere to manufacturer's instructions, contract drawings and specifications, and applicable codes, standards and regulations.

2) All software shall be of legal origin, and shall be supplied with the relevant licensing certificates. Licenses must be appropriate for the intended use. The Client shall be the owner of these licenses.

3) The South African Government's "*POLICY ON FREE and OPEN SOURCE SOFTWARE USE for SOUTH AFRICAN GOVERNMENT"* States that:

    1) The South African Government will implement FOSS unless proprietary software is demonstrated to be significantly superior. Whenever the advantages of FOSS and proprietary software are comparable FOSS will be implemented when choosing a software solution for a new project. Whenever FOSS is not implemented, then reasons must be provided in order to justify the implementation of proprietary software.

    2) The South African Government will migrate current proprietary software to FOSS whenever comparable software that have been identified by the State Information Technology Agency.

    3) All new software developed for or by the South African Government will be based on open standards, adherent to FOSS principles, and licensed using a FOSS license where possible, with the Client being the custodian and owner of the software.

    4) The South African Government will ensure all Government content and content developed using Government resources is made Open Content, unless analysis on specific content shows that proprietary licensing or confidentiality is substantially beneficial.

    5) The South African Government will encourage the use of Open Content and Open Standards within South Africa.

4) It is the responsibility of the contractor to ensure that software is compliant to all the requirements.

5) All software shall be Unicode compliant.

6) Software source code for custom developed solutions by the licensor and licensed to the Client to which the client only have a usage license shall be deposited with a third party escrow agent in the event that the licensor files for bankruptcy or otherwise fails to maintain and update the software as promised in the software license agreement, the software source code must be released to the licensee.

PS8.2 Firmware

1) All network and server hardware shall have the latest firmware revision installed as released by their manufacturer at site installation time. No third-party revisions shall be allowed.

2) Firmware revisions marked as "beta", "alpha", or "unstable" shall not be allowed. Only firmware revisions with the status of "release" or "release to manufacture" shall be allowed.

3) It is the responsibility of the contractor to ensure that the network and server hardware has the latest firmware revisions, and that the firmware is provided in a timely manner and notified to the Employer.

4) It is the responsibility of the contractor to ensure that the firmware is installed by a qualified technician.

PS8.3 Operating Systems

1) Operating systems shall be compatible with the architecture of the server hardware.

2) Each Server, Workstation, and Thin Client shall have the corresponding required license as required by the operating system manufacturer. The usage license shall not expire. The licenses

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shall include the usage of personnel and other computation devices as required. Licenses must be appropriate for the intended use. The Client shall be the owner of these licenses.

3) Operating systems shall be able to utilise the amount of cores per processor, as well as the amount of processors.

4) Operating systems shall be able to utilise the full architecture and features of the processor and motherboard. (E.g. an Operating system shall not be 32-Bit if the architecture is 64-Bit).

5) Operating systems shall be able to utilise 2GB of RAM per single process as a minimum.

6) Operating System shall have all the drivers installed to interface with the connected peripherals. The drivers shall be the latest "release" drivers available from the manufacturer of the Server, or the corresponding peripheral.

7) Operating Systems shall be approved by the Server manufacturer as being certified and supported Operating System.

8) Operating Systems shall be of "Microsoft", "Linux", "VMWare", "Solaris", "Novell & SCO", or "Citrix XenServer" make.

9) User friendly in nature, and provide commercial based educational support. (e.g. Readily available courses and/or literature).

10) Operating Systems shall come with a 2 year professional support service starting from the day the Client takes possession of the hardware on which the software is installed and configured. The support service shall be recognized by the Operating Systems' manufacturer. If the Operating System is younger than 1 year, from the day the Client takes possession of the hardware on which the software is installed and configured, then the period of professional support services shall be extended to 3 years.

11) It is the responsibility of the contractor to ensure that the correct amounts as indicated in the Bill of Quantities of Operating Systems are tendered for each Server.

12) It is the responsibility of the contractor to ensure that the Operating System is installed and configured by a qualified technician.

PS8.4 Database Systems

1) Database systems shall be compatible with the installed operating system.

2) Database systems shall have the corresponding licenses provided to the Client as owner. Licenses must be appropriate for the intended use.

3) Database systems shall be able to utilize the amount of cores per processors, as well as the amount of processors.

4) Database systems shall implement SQL as specified in the ISO/IEC 9075 standard.

5) Database systems shall be of type modern relational database management systems.

6) Database systems shall be able to handle "stored procedures".

7) Database systems shall be able to handle "replication".

8) Database systems shall be of "Oracle", "Microsoft", "Sun/MySQL", "EnterpriseDB/PostgreSQL", "Sybase", "Teradata", or "IBM".

9) Database Systems shall come with a 2 year professional support service starting from the day the Client takes possession of the hardware on which the software is installed and configured. The support service shall be recognized by the Database Systems' manufacturer. If the Database

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System is younger than 1 year, from the day the Client takes possession of the hardware on which the software is installed and configured, then the period of professional support services shall be extended to 3 years.

10) It is the responsibility of the contractor to ensure that the correct amounts as indicated in the Bill of Quantities of Database Systems are tendered for the appropriate Servers.

11) It is the responsibility of the contractor to ensure that the Database System is installed and configured by a qualified technician.

PS8.4 Network Management Systems

1) Network Management Systems shall be compatible with the installed operating system.

2) The Network Management Systems shall include:

    1) A Domain Controller service.

    2) A Directory service.

    3) Kerberos authentication.

    4) A DHCP service.

    5) A DNS service.

    6) A SMB service.

    7) A NTP service with a minimum of Stratum 2. If the network is segmented, then a dedicated Network Time Server with a minimum of Stratum 1 shall be supplied by the contractor. Stratum 0 servers shall only be referenced, as these are the atomic (caesium, rubidium) clocks, GPS clocks or other radio clocks.

3) Network Management Systems shall include the ability to distribute resources according to privilege levels. The contractor will be required to implement the relevant privilege levels. Privilege levels shall be based upon:

    1) Authority

    2) Department

    3) Position

4) Network Management Systems shall be installed on the Domain Controllers as required.

5) It is the responsibility of the contractor to ensure that the Network Management Systems is installed and configured by a qualified technician.

PS8.5 Malware Protection Systems

1) Malware Protection Systems shall be compatible with the installed operating system.

2) Malware Protection Systems shall be:

    1) ICSA Certified.

    2) VB100% Certified.

    3) W.C.L. Level 1 Certified.

    4) W.C.L. Level 2 Certified.

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5) Supplied with an Integrated Firewall.

6) The software package shall be able to download the latest available Virus Definitions from the manufacturer at a minimum of every 24Hours.

7) Centrally managed from the Primary Domain Controller or Backup Domain Controllers.

3) Malware Protection Systems shall be of “BitDefender”, “Kaspersky”, “AVG”, “F-Secure”, “Trend Micro”, “McAfee”, “Norton”, or “CA”.

4) Malware Protection Systems shall have a minimum license period of one (1) year starting from the day the Client takes possession of the hardware on which the software is installed and configured.

5) It is the responsibility of the contractor to ensure that the correct amounts as indicated in the Bill of Quantities of Malware Protection Systems are tendered for the appropriate Servers.

6) It is the responsibility of the contractor to ensure that the Malware Protection Systems is installed and configured by a qualified technician.

PS8.6 Office Productivity Suites

1) Office Productivity Suites shall be compatible with the installed operating system.

2) Office Productivity Suites shall be:

1) ISO/IEC 26300 (ODF) and/or ISO/IEC 29500 (OOXML) compliant.

2) Able to export documents as an ISO/IEC 32000 (PDF) document.

3) User friendly in nature, and provide commercial based educational support. (e.g. Readily available courses and/or literature).

3) Office Productivity Suites shall include:

1) Word Processors Tools

2) Presentation Tools

3) Spreadsheet Tools

4) Drawing Tools

5) Basic Database Tools

4) It is the responsibility of the contractor to ensure that the correct amounts as indicated in the Bill of Quantities of Office Productivity Suites are tendered for the appropriate Servers.

5) It is the responsibility of the contractor to ensure that the Office Productivity Suites is installed and configured by a qualified technician.

PS8.7 Intrusion Detection Systems

1) If one (1) or more Servers have been identified as Mission Critical and the Network connects to a WAN, an additional Server needs to be procured for the purposes of Intrusion Detection / Prevention. This Intrusion Detection / Prevention Server shall be identified as Mission Critical by default.

2) The Intrusion Detection System shall be:

1) Network intrusion detection system,

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2) Protocol-based intrusion detection system,

3) Host-based intrusion detection system (For all the Servers not just the Mission Critical ones), and

4) Application protocol-based intrusion detection system based.

3) The Intrusion Detection System shall be a Software based solution.

4) The Intrusion Detection System shall be of vendor: Top Layer Networks, DeepNines, Vern Paxson, Cisco Systems, e-Cop.net, Radware, Ltd., Enterasys Networks, Inc., Computer Associates, Juniper Networks, Network Associates, iPolicy Networks, Internet Security Systems, Intrusion, Check Point Software Technologies, Sourcefire, StoneSoft Corporation, StillSecure, Symantec Corporation, and TippingPoint Technologies. Other vendors needs to be approved by the Engineer.

5) The Intrusion Detection System shall have a minimum support license period of one (1) year starting from the day the Client takes possession of the hardware on which the software is installed and configured.

6) The Intrusion Detection System shall be compatible with the installed operating system.

7) It is the responsibility of the contractor to ensure that the Intrusion Detection System is installed and configured by a qualified technician.

PS8.8 Other Third-Party Software

1) All other software supplied shall be the latest version.

2) All other software supplied shall have the latest service packs and/or updates.

3) All other software supplied shall be compatible with the installed operating system.

4) All other software supplied shall be approved by the Engineer.

PS8.9 Message-Oriented Middleware

1) When specified or when the Root Network Layer's base speed is 10GBASE of the Network Topology, the contractor's integration shall strictly be done through a MOM Integration Suite. Any deviation from this requirement needs the approval from the Engineer.

2) MOM Integration Suite needs to:

1) Be Advanced Message Queuing Protocol (AMQP) compliant.

2) Be Java Message Service (JMS) capable.

3) Be Microsoft Message Queue (MSMQ) capable.

4) Be eXtended Mark-up Language (XML) capable.

5) Be asynchronous message-passing capable.

6) Must be able to provide persistent storage to back up the message transfer medium.

7) Must be able to deliver a single message to more than one recipient.

8) Provide sophisticated message transformation tools to allow programmers to specify transformation rules.

9) Be able to dynamically balance loads between multiple MOM servers.

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3) The MOM Integration Suite shall have a minimum support license period of one (1) year.

4) The MOM Integration Suite needs to be of vendor: IBM, Apache, Red Hat, Microsoft, Novell, Cisco, iMatix, SAP, TIBCO, Sun, Oracle, or TWIST. Any other vendors need to be approved by the Engineer.

5) It is the responsibility of the contractor to ensure that the MOM Integration Suite is installed and configured by a qualified developer.

PS8.10 Custom Integration Development

1) Custom integration software development shall either be through the ISO/IEC 14882 or the ISO/IEC 23270 programming languages.

2) It is the responsibility of the Contractor to obtain the necessary licenses of the Development Suites that is required to complete the integration tasks.

3) Software (and its source code) that will be developed specifically for the installation specified within the Scope of Work will become the intellectual property of the Client and accordingly no software licensing fees may be charged for such software.

4) Software developed specifically for the installation specified within the Scope of Work shall be tested through the use of Static Code Analysis Tools. It is the responsibility of the Contractor to facilitate these tests and provide detailed reports regarding each integration application.

PS9 ENCLOSURE HARDWARE

PS9.1 General

1) Telecommunications/Server/Distribution room layout, location and design shall be in accordance with the guidelines of ANSI/TIA/EIA-569-B. Telecommunications/Server/Distribution on each floor of the building should be centrally located and vertically aligned to simplify backbone cable and pathway routing. Telecommunications/Server/Distribution shall not be installed in wet areas, or near EMI sources or caustic chemicals.

2) Layout of rack, cabinet or enclosure locations shall be according to contract drawings.

3) Racks and cabinets shall be secured to the floor using proper anchors and fasteners.

4) Wall surfaces for mounting enclosures or brackets shall be prepared with a 20mm plywood backboard having two coats of fire-retardant paint applied.

5) Mount and assemble racks, cabinets, brackets and enclosures per manufacturer's instructions. Mount patch panels and cable management accessories in the specified locations.

6) Adjoining pathways (ladder, cable tray, etc.) shall be properly secured and positioned to allow adequate bend radius of cables entering the rack or cabinet.

PS9.2 Patch Panels

1) Augmented category 6 patch panels shall be a 19-inch rack mount design with 24, 48, or 96 port capacities. Construction shall be formed steel, powder coated with protected circuit boards and features to suppress alien crosstalk.

2) Augmented category 6 patch panels, when installed, shall exceed the link or channel performance requirements, in addition to alien crosstalk requirements of ANSI/TIA/EIA-568-B.

3) Properly mount patch panels into the designated rack, cabinet, or bracket locations with the #12-24 screws provided.

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4) Terminate cables behind the patch panel according to manufacturer's instructions. All patch panels are to be terminated with sufficient cable (gooseneck) to allow for the movement and reasonable access to the front and rear of the patch panel.

5) To assure 10GBase-T performance, maintain wiring pair twists as close as possible to the point of termination. Also minimize the length of exposed pairs from the jacket to the ICD termination point during installation.

6) Panels shall be properly labelled on the front and back with the cable number and port connections for each port.

7) It shall be the contractor's responsibility to ensure that he/she tender for the correct amount of patch panels.

PS9.3 Termination Blocks

1) Augmented Category 6 termination blocks shall utilize a category 6-110 punch-down system with 64-pair or 192-pair capacity. Construction shall be a polycarbonate base, either wall-mount or rack-mount style, with individual 4-pair connecting blocks.

2) Category 6-110 termination blocks, when installed, shall exceed the link or channel performance requirements, in addition to alien crosstalk requirements of ANSI/TIA/EIA-568-B.

PS9.4 Rack

1) Free standing communications racks shall be a floor-mounted formed/welded steel construction or aluminium channel construction, with powder coating. Racks shall be suitable for equipment rooms, telecommunications rooms, entrance facilities and data centres.

2) Racks shall have a full assortment of vertical and horizontal cable management accessories available.

3) Racks shall accommodate expansion of cable capacity and added volume for augmented category 6 cabling.

4) Network and server cabinets shall be free standing, full-size enclosed cabinets, with a formed, welded and powder coated construction. Network and server cabinets shall be suitable for equipment rooms, telecommunications rooms, and entrance facilities and data centres.

5) Cabinets shall be 19" rack mount style 42RU in height and 900mm deep where there are no space limitations. Cabinets shall be complete with steel doors and side panels with vented top panel. Cabinets shall be approved by the Project Engineer.

6) If there is a need to place a cabinet in an area of limited space then the option of a 600mm deep cabinet may be used upon approval of the Project Engineer.

7) All rack systems shall comply to ANSI/EIA-310-D.

8) Wall-mounted cabinets shall be formed/welded and powder coated construction, sized appropriately for the cable installation, and shall accept 19-inch patch panels. Wall-mounted cabinets may serve as a small telecommunications room, horizontal or intermediate cross connect facility, or consolidation point.

9) Wall-mounted enclosures shall be formed/welded and powder coated construction, sized appropriately for the cable installation, and shall accept 19-inch patch panels. Wall-mounted enclosures may serve as a small telecommunications room, horizontal or intermediate cross connect facility, or consolidation point.

10) All cabinets shall be installed with a dedicated protective earth back to the building protective earth system.

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11) All cabinets are to be lockable, front sides and rear to prevent unauthorised access to communications equipment, patch panels and cabling.

PS9.5 Installation environment

PS9.6 Power

1) All power requirements within the rack shall be supplied through UPS power.

2) The UPS hardware shall adhere to manufacturer's instructions, contract drawings and specifications, and applicable codes, standards and regulations.

3) UPS manufacturers shall be either "APC", "MGE", "Masterguard", "Eaton", or "Liebert".

4) The UPS power rating shall include all network and server equipment's power requirements plus an additional 40% with a minimum support time of 30 minutes.

5) The UPS shall be of the Dual Conversion, On-line type.

6) The UPS shall have a USB remote management interface connected to a Domain Controller.

7) The UPS shall have the ability to auto-restart of connected systems.

8) All power coming into the UPS shall be protected by a TVSS.

9) Power distribution units shall be supplied for each rack. Each Power distribution unit shall have 40% more power outlets than required within the rack.

10) TVSS manufacturers shall be either "Dehn", or "Phoenix".

11) TVSS shall be grounded as per their requirement set out by the manufacturer and regulations.

PS10 PLANNING

PS11 QUALITY PLAN

PS11.1 General Quality Plan

PS11.2 Cabling component acceptance tests

1) Augmented category 6 cabling systems shall be tested as an installed horizontal channel or permanent link configuration. Jacks and faceplates shall be assembled complete and properly mounted into outlet boxes. Panels shall be terminated complete and fully dressed with proper cable management. For channel testing, patch cords shall be connected into each end of the permanent link.

2) Each link or channel in the cabling system shall be identified and tested individually, using at minimum an industry standard level IIIe tester, capable of testing to TIA/EIA-568-B field test requirements.

3) Each link or channel shall be tested to 500 MHz for the augmented category 6 parameters listed below.

    1) Wire Map / Continuity

    2) Electrical length

    3) Insertion Loss

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4) NEXT

5) PSNEXT

6) ELFEXT

7) PSELFEXT

8) Delay and Delay Skew

9) Return Loss

4) Additional field testing, as required per TIA/EIA-568-B, shall be conducted by the test equipment to 500 MHz for alien cross-talk parameters listed below.

1) ANEXT

2) AFEXT

3) PSANEXT

4) PSAFEXT

5) A "PASS" indication shall be obtained for each channel or link, using at minimum a level IIIe tester that complies with TIA/EIA-568-B.2-10 (current draft) field test requirements.

PS11.3 Processing equipment acceptance tests

1) Servers and Workstations shall undergo the following acceptance tests:

1) A 24 Hour Burn-In Test.

2) A Fault Tolerance Test.

3) A Stress Test.

4) A Benchmarking Test.

5) The software that will execute the tests shall be "Passmark" or "SiSoftware". Any other software requires PE approval.

6) It is the responsibility of the contractor to execute, document and facilitate these tests.

PS11.4 Software component acceptance tests

PS11.5 Test equipment

PS11.6 Documentation

PS12 DOCUMENTATION

PS12.1 Test documentation

1) All test results are to be saved electronically, preferably on CD. Two sets of CDs shall be provided, one for the Client and one for the Client's representative. Test documentation submitted on disk shall be clearly marked on the cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). For multiple buildings, the building name, including floor or wing I.D. should also be included on the test results disk.

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2) File names of the test results recorded for each link or channel shall match the official identification. Test results shall include a complete record for each link or channel, including type of test, cable type, cable/port I.D., measurement direction, reference setup, date, and technician's name(s).

3) The test equipment name, manufacturer, model number, serial number, software version and last calibration date shall also be provided in the test results documentation.

4) When repairs and re-tests are performed, the problem cause and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

5) The owner, engineer, lead project manager, or owner's representative reserve the right to request verification of test results with a re-test of installed cables, on a sampling basis. Re-testing shall be at the expense of the installer unless otherwise noted in the contract documents.

PS12.2 As-built documentation

1) Deviations from the approved drawings, whether or not a change order is submitted, shall be clearly denoted as built on the working hard copy drawing by the telecommunications contractor. As-built drawings shall be returned promptly to the owner or design agent for completion of drafting revisions to the original design. Manufacturer's warranty registrations may also require as-built drawings.

2) Floor plan drawings shall at minimum include detailed cable and pathway layouts, exact locations of workstation outlets, and cable distribution hardware locations. Workstation outlets shall have alphanumeric identifiers on the drawings as specified by the end user or owner.

3) Cabinet layouts.

4) Communications system including location of Equipment Rooms, Telecommunications Closets, Distributors, Pathways and Cabinets.

5) All drawings, prints and electronic versions on CD shall be included in the Contractors' price.

PS12.3 Cabling documentation

1) Identification and labelling shall follow the guidelines of ANSI/TIA/EIA-606-A. Mandatory minimum labelling shall include pathways, Telecommunications Room (Server Room)'s, ER's, EF's, cable ends behind panels and wall outlets, wall outlet ports, patch panels and ports, fire stops, and grounding/bonding locations.

2) Labels shall be permanent, with machine-generated identification codes according to specification. Tape with hand-written labels will not be accepted..

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ANNEXURE E:

FIBRE OPTIC COMMUNICATION SYSTEM SPECIFICATIONS

CITY OF CAPE TOWN

TRANSPORT ROADS & STORMWATER

CONTRACT NO. 24G/2009/10

DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING, AND COMMISSIONING OF THE IRT FARE SYSTEM, THE SUPPLY AND DISTRIBUTION OF FARE CARDS, AND THE PROVISION OF MAINTENANCE AND OTHER RELATED SERVICES

SCOPE OF WORKS

ANNEXURE E: FIBRE OPTIC COMMUNICATION SYSTEM SPECIFICATION

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PS1 SCOPE

This section covers the network design, supply, delivery and installation of fibre optic cable/equipment.

PS2 STANDARDS

All material/equipment shall comply with the relevant current SABS, BSI and/or IEC standards.

The following standards may be used as a guide but must not be regarded as a complete list:

IEC 60793-1	: Optical fibres	: Part 1	Generic specification
IEC 60793-1-1	: Optical fibres	: Part 1	Generic specification - Section 1 General
IEC 60793-1-4	: Optical fibres	: Part 1	Generic specification - Section 4 Measuring methods for transmission and optical characteristics
IEC 60793-2	: Optical fibres	: Part 2	Product specifications
IEC 60794-1	: Optical fibre cables	: Part 1	Generic specification
IEC 60794-2	: Optical fibre cables	: Part 2	Product specifications
IEC 60794-3	: Optical fibre cables	: Part 3	Telecommunications cables - Sectional specification
IEC 60869-1	: Fibre optic attenuators	: Part 1	Generic specification
IEC 61073-1	: Splices for optical fibres and cables	: Part 1	Generic specification - Hardware and accessories

PS3 FIBRE OPTIC CABLE

The cable type and fibre count required in each section of the fibre optic network is dependant on the type of installation and will be selected by the Contractor after consultation with the Engineer.

Geometric Characteristics

Cladding diameter	125 µm
Core/cladding concentricity error	≤ 1.5 dB/km
Cladding non-circularity	≤ 0.28 dB/km
Coating diameter	1100 – 1280 nm
Coating concentricity	9.2 ± 0,5 µm
Coating non-circularity	1300 – 1325 nm

PS3.1 Insulation

The insulation material shall comprise of PVC in accordance with the latest edition of SABS 1411: Part II.

PS3.2 Bedding

The bedding shall consist of a continuous PVC extruded sheath.

PS3.3 Armouring – (where specified)

The armouring shall consist of one layer of round galvanised steel wire complying with the requirements of the latest edition of SABS 1411: Part VI

PS3.4 Serving

An impermeable PVC outer sheath complying with the latest edition of SABS 1411: Part II shall be provided.

PS3.5 Cable Drums

The cable drums shall be capable of taking a round spindle and be lagged with strong, closely fitted battens, at the inner and outer circumference so as to prevent damage to the cables. The spindle bearing plates shall be steel. The dimensions of the drum shall not exceed 1 100-mm width, 2 000-mm diameter and the spindle bearing plate shall not be less than 9 mm thick. Each drum shall be clearly marked on both sides in accordance with the latest edition of SABS 1507.

Suitable protective caps shall be fitted to the exposed ends of the optical fibre cable to avoid penetration of moisture. Each cable drum shall be numbered. End caps should be handled carefully to avoid damage during installation, and any damage caps should be replaced.

PS4 FIBRE OPTIC CABLE INSTALLATION

PS4.1 Cable Minimum Bending Radius

Irrespective of the type of installation and cable, it shall be ensured that the minimum bending radius - as prescribed by the cable manufacturer – is never exceeded during handling and installation. In general the minimum bending radius for a fibre optic is as follows:

Right angles : 12 – 14 times the cable outer diameter

Coiling : 25 times the cable outer diameter

PS4.2 Installation in Trench

The installation in trench and the trench specification shall be as per STD SPEC: MEDIUM VOLTATGE AND LOW VOLTAGE CABLE INSTALLATION included in this document.

When the trench is filled, compacting machinery shall be employed only when coverage of the cable is at least 300mm deep.

It shall be ensured that the maximum allowable pulling force as prescribed by the cable manufacturer is never exceeded during installation.

PS4.3 Installation in Sleeves

The supply and installation of the required sleeves shall be as per STD SPEC: SUPPLY AND INSTALLATION OF CABLE SLEEVE PIPES included in this document.

It shall be ensured that the maximum allowable pulling force as prescribed by the cable manufacturer is never exceeded during installation.

PS4.4 Vertical Installations and or Cable Rack/Ladder

The installation of fibre cable on cable ladder or racks shall be as per STD SPEC: CABLE TRAYS AND LADDER RACKS included in this document.

It shall be ensured that the maximum unsupported length as prescribed by the cable manufacturer, is never exceeded.

PS4.5 Overhead Installations

Where applicable, the supply and installation of the overhead masts/poles, pole trays and ancillary equipment shall be as per STD SPEC: BARE CONDUCTOR OVERHEAD POWERLINES included in this document.

Only purpose-made reinforced aerial fibre cable shall be employed for overhead lines. The maximum span and deflection as prescribed by the cable manufacturer shall never be exceeded.

PS4.6 Marking of Cables and Cable Routes

The marking of the cables and cable routes shall be as per STD SPEC: MEDIUM VOLTAGE AND LOW VOLTAGE CABLE INSTALLATION included in this document.

PS5 JOINTS/ FUSION SPLICING

The installation of fusion splices shall be compliant with the following:

(a) All splicing shall be of the fusion splice type and no mechanical splices are to be used.

(b) A maximum splice insertion loss of 0.3dB per splice shall be allowed.

(c) All fusion splices shall be done in splice enclosures of the correct type and size suitable for the environment and specific installation and shall have a warning label affixed unto the outside cover.

(d) All splice joints shall have a splice protector over them.

(e) All splice enclosures shall have a record sheet/label inside denoting the planning and use of the fibers according to colour coding and/or numbering. Furthermore, this shall be dated and labelled according to areas and/or signals in use. A detailed plan of all splice enclosure locations, and their detail, shall be submitted.

PS6 OPTICAL FIBRE CONNECTORS

All optical fibre ends shall be terminated to a cylindrical ferrule connector similar to the straight tip (ST) type connector or equal and approved by the Engineer.

All connectors shall be supplied with end caps protecting the connector against moisture and dust or damage.

All pigtail connecting cables shall be supplied in a minimum length of 3 meter or as specified in the detail specification.

A maximum insertion loss of 0.5dB per connector shall be allowed.

PS7 INTERFACE EQUIPMENT

The optical fibre installation shall include all fibre to copper interface units to allow for communication between field and local networks.

PS8 INTERFACE EQUIPMENT

PS8.1 Termination conversion equipment shall be “Telest” or similar and approved 19-inch rack mount.

PS8.2 The equipment shall have “fine” over voltage protection equipment in series with the external power supply.

PS8.3 Each fibre driver comprising eight channels or more shall be installed with a cable management brush panel below the unit.

PS8.4 All cable connectors shall be labelled as specified in this document.

PS8.5 Unless specified to the contrary, each driver will be installed with a 19-inch rack mount UPS unit.

PS8.6 The UPS unit shall provide a minimum of 20 minutes of power backup to the driver/drivers in the cabinet.

PS8.7 The UPS unit shall be MGE Pulsar, or Masterguard Series A-19 true on-line double conversion units or similar and approved units.

PS9 TESTING AND COMMISSIONING

The contractor shall provide all equipment, instrumentation and supplies necessary to perform site testing and commissioning.

Original copies of all data produced, including results of each test procedure shall be submitted to the engineer at the conclusion of each phase of testing.

During the testing and commissioning period, the contractor shall identify failures, determine causes of failures and deliver a written report to the engineer detailing the nature of each failure the corrective action taken, results of tests performed and shall recommend when testing should be resumed.

PS9.1 Optical Fibre LAN Tests

(a) Optical Time Domain Reflectometer (OTDR) Tests

OTDR tests shall be performed on each section of the optical fibre network indicating any optical fibre breaks or splice losses and a printout report shall be submitted to the Engineer for approval before acceptance of the installation.

The contractor shall provide all equipment, instrumentation and supplies necessary to perform the required site testing and commissioning.

Original copies of all data produced, including results of each test procedure shall be submitted to the engineer at the conclusion of each phase of testing.

(b) Power Meter and Light Source Tests (PMLS)

PMLS tests shall be performed on each section of the optical fibre network and a printout report shall be submitted to the Engineer for approval before acceptance of the installation.

The contractor shall provide all equipment, instrumentation and supplies necessary to perform site testing and commissioning.
Original copies of all data produced, including results of each test procedure shall be submitted to the engineer at the conclusion of each phase of testing

PS10 DRAWINGS AND DOCUMENTATION

The Contractor shall be responsible to provide schematics showing system architecture, layout and wiring drawings as part of the O&M manuals.

All the required drawings shall be as per STD SPEC: CONTRACT ADMINISTRATION AND GENERAL REQUIREMENTS included in this document.

PS11 MEASUREMENT AND PAYMENT

Item		Unit
PS11.1	Supply and deliver armoured optical fibre cable.	m

The unit of measurement shall be the length in meter of SWA/STA optical fibre cable supplied.

The tendered rate shall include full compensation for the supply and delivery of the specified STA/SWA optical fibre cable.

Item		Unit
PS11.2	Install armoured optical fibre cable	m

The unit of measurement shall be the length in meter of STA/SWA optical fibre cable installed.

The tendered rate shall include full compensation for the installation of the specified STA/SWA optical fibre cable in cable trenches including the required installation material.

Item		Unit
PS11.3	Supply, delivery, installation, testing and commissioning of optical fibre fusion splice enclosures.	No

The unit of measurement shall be the number of fusion splices enclosures supplied, delivered, installed, tested and commissioned.

The tendered rate shall include full compensation for the supply, delivery, installation, testing and commissioning of fibre optic fusion splices enclosures as specified.

Item		Unit
PS11.4	Installation, testing and commissioning of optical fibre fusion splices.	No

The unit of measurement shall be the number of optical fibre cable ends spliced. The cable ends shall be measured and not each optical fusion splice.

The tendered rate shall include full compensation for the installation, testing and commissioning of the fusion splices to render a complete and functional fusion splice. The tendered rate shall furthermore provide all equipment, instrumentation and supplies necessary to perform the fusion splices.

Item		Unit
PS11.5	Supply, delivery, installation, testing and commissioning of fibre optic pigtails.	No

The unit of measurement shall be the number of fibre optic pigtails supplied, delivered to site, installed and commissioned.

The tendered rate shall include full compensation for the supply, delivery, installation, testing and commissioning of the required optical fibre pigtails.

Item		Unit
PS11.6	Supply and deliver optical fibre/wire interface units	No

The tendered rates shall include for the supply, manufacture, testing and delivery of the required amount of optical fibre to wire - and vice versa - interface units. The rates shall be all inclusive of all material including power supplies, wiring, enclosures, etc. to represent a complete installable unit.

Item		Unit
PS11.7	Install and test optical fibre/wire interface units	No

The tendered rates shall include for full compensation for the installation and testing of the interface units including all material and labour to complete the installation.

Item		Unit
PS11.8	Supply and deliver optical fibre patch panels	No

The tendered rates shall include for the supply, manufacture, testing and delivery of the required amount of optical fibre patch panels. The rates shall be all inclusive of all material to represent a complete installable unit.

Item		Unit
PS11.9	Install and test optical fibre patch panels	No

The tendered rates shall include for full compensation for the installation and testing of the optical fibre patch panels including all material and labour to complete the installation.

Item		Unit
PS11.10	Perform OTDR tests on the optical fibre LAN	Lump Sum

The unit of measurement shall be a Lump Sum.

The tendered sum shall include full compensation to perform OTDR tests on the optical fibre network. The tendered sum shall furthermore provide all equipment, instrumentation and supplies necessary to perform site testing and reporting to the Engineer.

Item		Unit
PS11.11	Perform PMLS tests on the optical fibre LAN	Lump Sum

The unit of measurement shall be a Lump Sum.

The tendered sum shall include full compensation to perform power meter and Light source tests on the optical fibre network. The tendered sum shall furthermore provide all equipment, instrumentation and supplies necessary to perform site testing and reporting to the Engineer.

ANNEXURE F:
REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS

CITY OF CAPE TOWN

TRANSPORT ROADS & STORMWATER

CONTRACT NO. 24G/2009/10

DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING, AND COMMISSIONING OF THE IRT FARE SYSTEM, THE SUPPLY AND DISTRIBUTION OF FARE CARDS, AND THE PROVISION OF MAINTENANCE AND OTHER RELATED SERVICES SCOPE OF WORKS

ANNEXURE F: REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS

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1.0 SCOPE

This part of the specification has the objective to assist principal contractors entering into contracts with the City of Cape Town that they comply with the Occupational Health and Safety (OH&S) Act, No. 85 of 1993. Compliance with this document does not absolve the principal contractor from complying with minimum legal requirements and the principal contractor remains responsible for the health and safety of his employees and those of his Mandataries. Principal and other contractors should therefore insist that this part of the specification form part of any contract that he may have with other contractors and/or suppliers.

This section covers the development of a health and safety specification that addresses all aspects of occupational health and safety as affected by this contract. It provides the requirements that principal contractors and other contractors shall comply with in order to reduce the risks associated with this contract that may lead to incidents causing injury and/or ill health.

2.0 GENERAL OCCUPATIONAL HEALTH AND SAFETY PROVISIONS

2.1 Hazard Identification and Risk Assessment (Construction Regulation 7)

2.1.1 Risk Assessments

Paragraph 4 contains a generic list of risk assessment headings that have been identified by City of Cape Town as possibly applicable to this contract. It is, by no means, exhaustive and is offered as assistance to contractors intending to tender.

2.1.2 Development of Risk Assessments

Every principal contractor performing construction work shall, before the commencement of any construction work or work associated with the aforesaid construction work and during such work, cause a risk assessment to be performed by a competent person, appointed in writing, and the risk assessment shall form part of the OH&S plan and be implemented and maintained as contemplated in Construction Regulation 5(1).

The risk assessment shall include, at least:

- the identification of the risks and hazards to which persons may be exposed
- the analysis and evaluation of the risks and hazards identified
- a documented plan of safe work procedures to mitigate, reduce or control the risks and hazards that have been identified
- a monitoring plan and
- a review plan

Based on the risk assessment, the principal contractor shall develop a set of site-specific OH&S rules that shall be applied to regulate the OH&S aspects of the construction. The risk assessment, together with the site-specific OH&S rules shall be submitted to City of Cape Town before construction on site commences. Despite the risk assessments listed in paragraph 4, the principal contractor shall conduct a baseline risk assessment and the aforesaid listed risk assessment shall be incorporated into the baseline risk assessment. The baseline risk assessment shall further include the standard working procedures and the applicable method statements based on the risk assessments

All variations to the scope of work shall similarly be subjected to a risk assessment process.

2.1.3 Review of Risk Assessment

The principal contractor shall review the hazard identification, risk assessments and standard working procedures at each production planning and progress report meeting as the contract work develops and progresses and each time changes are made to the designs, plans and construction methods and processes. The principal contractor shall provide City of Cape Town, other contractors and all other concerned parties with copies of any changes, alterations or amendments as contemplated in paragraph 2.1.3.

2.2 Legal Requirements

A principal contractor shall, as a minimum, comply with:

The Occupational Health and Safety Act and Regulations (Act 85 of 1993), an up-to-date copy of which shall be available on site at all times.
The Compensation for Occupational Injuries and Diseases Act (Act 130 of 1993), an up-to-date copy of which shall be available on site at all times.
Where work is being carried out on a "mine", the contractor shall comply with the Mines Health and Safety Act and Regulations (Act 29 of 1960) and any other OH&S requirements that the mine may specify. An up-to-date copy of the Mines Health and Safety Act and Regulations shall be available on site at all times.

2.3 Structure and Responsibilities

2.3.1 Overall Supervision and Responsibility for OH&S

It is a requirement that the principal contractor, when he appoints contractors (Sub-contractors) in terms of Construction Regulations 5(3), 5(5), 5(9), 5(10) and 5(12) includes in his agreement with such contractors the following:

- OH&S Act (85 of 1993), Section 37(2) agreement: "Agreement with Mandatary"
- OH&S Act (85 of 1993), Section 16(2) appointee/s as detailed in his/her/their respective appointment forms.

2.3.2 Further (Specific) Supervision Responsibilities for OH&S

The contractor shall appoint designated competent employees and/or other competent persons as required by the Act and Regulations. Below is a generic list of identified appointments and may be used to select the appropriate appointments for this contract. The contractor shall note that it is a generic list only and is intended for use as a guideline.

Ref. Section/Regulation in OHS Act	
Batch Plant Supervisor	(Construction Regulation 6(1)
Construction Vehicles/Mobile Plant/Machinery Supervisor	(Construction Regulation 21)
Demolition Supervisor	(Construction Regulation 12)
Drivers/Operators of Construction Vehicles/Plant	(Construction Regulation 21)
Electrical Installation and Appliances Inspector	(Construction Regulation 22)
Emergency/Security/Fire Coordinator	(Construction Regulation 27)
Excavation Supervisor	(Construction Regulation 11)
Explosive Powered Tool Supervisor	(Construction Regulation 19)
Fall Protection Supervisor	(Construction Regulation 8)
First Aider	(General Safety Regulation 3)
Fire Equipment Inspector	(Construction Regulation 27)
Formwork & Support work Supervisor	(Construction Regulation 10)
Hazardous Chemical Substances Supervisor	(HCS Regulations)
Incident Investigator	(General Admin Regulation 29)
Ladder Inspector	(General Safety Regulation 13A)

Lifting Equipment Inspector	(Construction Regulation 20)
Materials Hoist Inspector	(Construction Regulation 17)
OH&S Committee	(OHSAct Section 19)
OH&S Officer	(Construction Regulation 6(6)
OH&S Representatives	(OHSAct Section 17)
Person Responsible for Machinery	(General Machinery Regulation 2)
Scaffolding Supervisor	(Construction Regulation 14)
Stacking & Storage Supervisor	(Construction Regulation 26)
Structures Supervisor	(Construction Regulation 9)
Suspended Platform Supervisor	(Construction Regulation 15)
Tunneling Supervisor	(Construction Regulation 13)
Vessels under Pressure Supervisor	(Vessels under Pressure Regulations)
Working on/next to Water Supervisor	(Construction Regulation 24)
Welding Supervisor	(General Safety Regulation 9)

In addition City of Cape Town requires that a Traffic Safety Officer be appointed (see COLTO Section 1500). The above appointments shall be in writing and the responsibilities clearly stated together with the period for which the appointment is made. This information shall be communicated and agreed with the appointees. Notice of appointments shall be submitted to City of Cape Town. All changes shall also be communicated to City of Cape Town.

The principal contractor shall, furthermore, provide City of Cape Town with an organogram of all contractors that he/she has appointed or intends to appoint and keep this list updated and prominently displayed on site. Where necessary, or when instructed by an inspector of the Department of Labour, the principal contractor shall appoint a competent construction safety officer.

2.3.3 Designation of OH&S Representatives (Section 17 of the OH&S Act)

Where the principal contractor employs more than 20 persons (including the employees of other contractors (sub-contractors) he has to appoint one OH&S representatives for every 50 employees or part thereof. General Administrative Regulation 6 requires that the appointment or election and subsequent designation of the OH&S representatives be conducted in consultation with employee representatives or employees. (Section 17 of the Act and General Administrative Regulation 6 & 7). OH&S representatives shall be designated in writing and the designation shall include the area of responsibility of the person and term of the designation.

2.3.4. Duties and Functions of the OH&S Representatives (Section 18 of the OH&S Act)

The principal contractor shall ensure that the designated OH&S representatives conduct continuous monitoring and regular inspections of their respective areas of responsibility using a checklist and report thereon to the principal contractor. OH&S representatives shall be included in accident or incident investigations. OH&S representatives shall attend all OH&S committee meetings.

2.3.5. Appointment of OH&S Committee (Sections 19 and 20 of the OH&S Act)

The principal contractor shall establish an OH&S committee, which shall meet as specified in the Regulations.

2.4. Administrative Controls and the Occupational Health & Safety File

2.4.1. The OH&S File (Construction Regulation 5 (7))

As required by Construction Regulation 5(7), the principal contractor and other contractors shall each keep an OH&S file on site. The following list is not exhaustive and shall only be used as a guide:

- Notification of construction work (Construction Regulation 3)
- Latest copy of OH&S Act (General Administrative Regulation 4)
- Proof of registration and good standing with COID Insurer (Construction Regulation 4 (g)
- OH&S plan agreed with the Client including the underpinning risk assessment/s and method statements (Construction regulation 5 (1))
- Copies of OH&S committee and other relevant minutes
- Designs/drawings (Construction Regulation 5 (8)
- A list of contractors (sub-contractors) including copies of the agreements between the parties and the type of work being done by each contractor (Construction Regulation 9)
- Appointment/designation forms as per paragraphs 2.1.1 and 2.1.2.
- Registers as follows:
    - Accident/Incident register (Annexure 1 of the General Administrative Regulations)
    - OH&S representatives' inspection register
    - Asbestos demolition and stripping register
    - Batch plant inspections
    - Construction vehicles and mobile plant inspections by controller
    - Daily inspection of vehicles, plant and other equipment by the operator/driver/user
    - Demolition inspection register
    - Designer's inspection of structures record
    - Electrical installations, -equipment and -appliances (including portable electrical tools)
    - Excavations inspection
    - Explosive powered tool inspection, maintenance, issue and returns register (incl. cartridges and nails)
    - Fall protection inspection register
    - First aid box contents
    - Fire equipment inspection and maintenance
    - Formwork and support work inspections
    - Hazardous chemical substances record
    - Ladder inspections
    - Lifting equipment register
    - Materials hoist inspection register
    - Machinery safety inspection register (incl. machine guards, lock-outs etc.)
    - Scaffolding inspections
    - Stacking and storage inspection
    - Inspection of structures
    - Inspection of suspended platforms
    - Inspection of tunnelling operations
    - Inspection of vessels under pressure
    - Welding equipment inspections
    - Inspection of work conducted on or near water
    - All other applicable records including traffic safety officer reports.

City of Cape Town will conduct an audit on the OH&S file of the principal contractor from time-to-time.

2.5. Notification of Construction Work (Construction Regulation 3)

The principal contractor shall, where the contract meets the requirements laid down in Construction Regulation 3, within 5 working days, notify the Department of Labour of the intention to carry out construction work and use the form (Annexure A in the Construction Regulations) for

the purpose. A copy shall be kept on the OH&S file and a copy shall be forwarded to CITY OF CAPE TOWN for record keeping purposes.

2.6. Training and Competence

The contents of all training required by the Act and Regulations shall be included in the principal contractor's OH&S plan. The principal contractor shall be responsible for ensuring that all relevant training is undertaken. Only accredited service providers shall be used for OH &S training. The principal contractor shall ensure that his and other contractors' personnel appointed are competent and that all training required to do the work safely and without risk to health, has been completed before work commences. The principal contractor shall ensure that follow-up and refresher training is conducted as the contract work progresses and the work situation changes. Records of all training must be kept on the OH&S file for auditing purposes.

2.7 Consultations, Communication and Liaison

OH&S liaison between the client, the principal contractor, the other contractors, the designer and other concerned parties will be through the OH&S committee as contemplated in paragraph 2.3.5. In addition to the above, communication may be directly to the client or his appointed agent, verbally or in writing, as and when the need arises.

Consultation with the workforce on OH&S matters will be through their supervisors, OH&S representatives and the OH&S committee. The principal contractor shall be responsible for the dissemination of all relevant OH&S information to the other contractors e.g. design changes agreed with the client and the designer, instructions by the client and/or his/her agent, exchange of information between contractors, the reporting of hazardous/dangerous conditions/situations etc. The principal contractors' most senior manager on site shall be required to attend all OH&S meetings.

2.8 Checking, Reporting and Corrective Actions

2.8.1. Monthly Audit by Client (Construction Regulation 4(1)(d)

City of Cape Town will conduct monthly audits to comply with Construction Regulation 4(1)(d) to ensure that the principal contractor has implemented and is maintaining the agreed and approved OH&S plan.

2.8.2. Other Audits and Inspections by City of Cape Town

City of Cape Town reserves the right to conduct other ad hoc audits and inspections as deemed necessary. This will include site safety walks.

2.8.3 Contractor's Audits and Inspections

The principal contractor is to conduct his own monthly internal audits to verify compliance with his own OH&S management system as well as with this specification.

2.8.4 Inspections by OH&S Representative's and other Appointees

OH&S representatives shall conduct weekly inspections of their areas of responsibility and report thereon to their foreman or supervisor whilst other appointees shall conduct inspections and report thereon as specified in their appointments e.g. vehicle, plant and machinery drivers, operators and users must conduct daily inspections before start-up.

2.8.5 Recording and Review of Inspection Results

All the results of the abovementioned inspections shall be in writing, reviewed at OH&S committee meetings, endorsed by the chairman of the meeting and placed on the OH&S File.

2.9 Accidents and Incident Investigation (General Administrative Regulation 9)

The principal contractor shall be responsible for the investigation of all accidents/incidents where employees and non-employees were injured to the extent that he/she/they had to be referred for medical treatment by a doctor, hospital or clinic. The results of the investigation shall be entered into an accident/incident register listed in paragraph 2.4.1.

The principal contractor shall be responsible for the investigation of all minor and non-injury incidents as described in Section 24 (1) (b) & (c) of the Act and keeping a record of the results of such investigations including the steps taken to prevent similar accidents in future.

2.10 Reporting

The principal contractor shall provide City of Cape Town with copies of all statutory reports required in terms of the Act within 7 days of the incident occurring.

3.0 OPERATIONAL CONTROL

3.1 Operational Procedures

Each construction activity shall be assessed by the principal contractor so as to identify operational procedures that will mitigate against the occurrence of an incident during the execution of each activity. This specification requires the principal contractor:

- to be conversant with Regulations 8 to 29 (inclusive)
- to comply with their provisions
- to include them in his OH&S plan where relevant.

3.2. Emergency Procedures

Simultaneous with the identification of operational procedures (per paragraph 3.1 above), the principal contractor shall similarly identify and formulate emergency procedures in the event an incident does occur. The emergency procedures thus identified shall also be included in the principal contractor's OH&S plan.

3.3 Personal & Other Protective Equipment (Sections 8/15/23 of the OH&S Act)

The contractor shall identify the hazards in the workplace and deal with them. He must either remove them or, where impracticable, take steps to protect workers and make it possible for them to work safely and without risk to health under the hazardous conditions.

Personal protective equipment (PPE) should, however, be the last resort and there should always first be an attempt to apply engineering and other solutions to mitigating hazardous situations before the issuing of PPE is considered.

Where it is not possible to create an absolutely safe and healthy workplace the contractor shall inform employees regarding this and issue, free of charge, suitable equipment to protect them from any hazards being present and that allows them to work safely and without risk to health in the hazardous environment.

It is a further requirement that the contractor maintain the said equipment, that he instructs and trains the employees in the use of the equipment and ensures that the prescribed equipment is used by the employee/s.

Employees do not have the right to refuse to use/wear the equipment prescribed by the employer and, if it is impossible for an employee to use or wear prescribed protective equipment through health or any other reason, the employee cannot be allowed to continue working under the hazardous condition/s for which the equipment was prescribed but an alternative solution has to be found that may include relocating or discharging the employee.

The principal contractor shall include in his OH&S plan the PPE he intends issuing to his employees for use during construction and the sanctions he intends to apply in cases of non conformance by his employees. Conformance to the wearing of PPE shall be discussed at the weekly inspection meetings.

3.4 Other Regulations

Wherever in the Construction Regulations or this specification there is reference to other regulations (e.g Construction Regulation 22: Electrical Installations and Machinery on Construction Sites) the principal contractor shall be conversant with and shall comply with these regulations.

3.5 Public Health & Safety (Section 9 of the OH&S Act)

The principal contractor shall be responsible for ensuring that non-employees affected by the construction work are made aware of the dangers likely to arise from said construction work as well as the precautionary measures to be observed to avoid or minimise those dangers. This includes:

- Non- employees entering the site for whatever reason
- The surrounding community
- Passers by to the site

4.0 PROJECT/SITE SPECIFIC REQUIREMENTS

4.1 List Of Risk Assessments

- Clearing and Grubbing of the area/site
- Site establishment including:
    - Office/s
    - Secure/safe storage for materials, plant and equipment
    - Ablutions
    - Sheltered eating area
    - Maintenance workshop
    - Vehicle access to the site
- Dealing with existing structures
- Location of existing services
- Installation and maintenance of temporary construction electrical supply, lighting and equipment
- Adjacent land uses/surrounding property exposures
- Boundary and access control/public liability exposures (NB: the employer is also responsible for the OH&S of non-employees affected by his/her work activities.)
- Health risks arising from neighbouring as well as own activities and from the environment e.g. threats by dogs, bees, snakes, lightning etc.
- Exposure to noise
- Exposure to vibration
- Protection against dehydration and heat exhaustion
- Protection from wet and cold conditions
- Dealing with HIV/Aids and other diseases
- Use of portable electrical equipment including

    - Angle grinder
    - Electrical drilling machine
    - Skill saw
- Excavations including
    - Ground/soil conditions
    - Trenching
    - Shoring
    - Drainage of trench
- Welding including
    - Arc welding
    - Gas welding
    - Flame cutting
    - Use of LP gas torches and appliances
- Loading and offloading of trucks
- Aggregate/sand and other materials delivery
- Manual and mechanical handling
- Lifting and lowering operations
- Driving and operation of construction vehicles and mobile plant including
    - Trenching machine
    - Excavator
    - Bomag roller
    - Plate compactor
    - Front end loader
    - Mobile cranes and the ancillary lifting tackle
    - Parking of vehicles and mobile plant
    - Towing of vehicles and mobile plant
- Use and storage of flammable liquids and other hazardous substances
- Layering and bedding
- Installation of pipes in trenches
- Pressure testing of pipelines
- Backfilling of trenches
- Protection against flooding
- Gabion work
- Use of explosives
- Protection from overhead power lines
- As discovered by the principal contractor's hazard identification exercise
- As discovered from any inspections and audits conducted by the client or by the principal contractor or any other contractor on site
- As discovered from any accident/incident investigation.

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ANNEXURE G:

BANK ISSUED FARE MEDIA AND RELATED INFRASTRUCTURE SPECIFICATION

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CITY OF CAPE TOWN

TRANSPORT ROADS & STORMWATER

CONTRACT NO. 24G/2009/10

DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING, AND COMMISSIONING OF THE IRT FARE SYSTEM, THE SUPPLY AND DISTRIBUTION OF FARE CARDS, AND THE PROVISION OF MAINTENANCE AND OTHER RELATED SERVICES

SCOPE OF WORKS

ANNEXURE G: BANK ISSUED FARE MEDIA AND RELATED INFRASTRUCTURE SPECIFICATION

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SPECIFICATION: BANK ISSUED FARE MEDIA AND RELATED INFRASTRUCTURE

1 GENERAL

1.1 This specification comprises all aspects regarding the Bank Issued Fare Media based on the EMV standard as well as the related equipment and infrastructure for Automatic Fare Collection for the new BRT stations and feeder busses in the greater Cape Town Metropolitan area.

1.2 All work shall be scheduled in liason with the Main Contractor to suit his master program.

1.3 Notwithstanding the fact that the banking industry via PASA is in the process of submitting an application to National Treasury and the Financial Intelligence Centre for an exemption from the provisions of the Financial Intelligence Centre Act for low value contactless payment products, it is incumbent on all tenderers to ensure that all relevant legislation, regulations and guidelines are adhered to in their proposed solutions. Tender responses must include relevant proposals on the employment of processes to meet the requirements of the Financial Intelligence Centre.

2 SCOPE OF WORKS

2.1 The scope of the installation shall comprise of:

- EMV smart cards with a contactless transaction interface (MasterCard PayPass and Visa payWave) issued by Payments Association of South Africa (PASA) member banks according to regulations and rules endorsed by PASA and which carry the National Department of Transport AFC Data Structure.
- EMV compliant contactless card readers integrated within fare collection terminal devices installed in vehicles and access gates
- EMV compliant certified Point-of-sale terminals for the acceptance of contact debit and credit card transactions
- Card vending machines for the dispensing of cards and the loading of transit products
- EMV pre-authorised debit transaction processing and communication
- EMV Issuer-to-Card Script Processing
- [PCI-DSS compliance]
- Site supervision
- Production of “as-built” drawings

3 STANDARD SPECIFICATIONS, REGULATIONS AND CODES

3.1 The latest edition, including all amendments up to date of tender of the following Acts of Parliament, regulations, specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- National Land Transport Transition Act and regulations promulgated in terms of the Act
- Occupational Health and Safety Act

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- Relevant regulations and rules for Payments Association of South Africa (PASA) member Issuing and Acquiring Banks
- Relevant card association rules [ie. Visa or MasterCard Operating Regulations]
- National Payment System Act
- South African Reserve Bank Position Paper on Electronic Money
- The Banks Act
- Consumer Protection Act
- National Department of Transport AFC Guideline Document
- Manufacturer's specifications and installation instructions

3.2 The Contractor shall ensure that all safety regulations and measures are applied and enforced during construction, repair and maintenance work on cabling, wiring, distribution boards, luminaires and power outlets.

3.3 The Contractor shall ensure that his company is registered to execute work in the Cape Town Metropolitan area.

4 CONSTRUCTION PROGRAMME

4.1 The Contractor's programme shall be co-ordinated with the programme of the Project Manager and shall include allowance for adverse weather conditions, builders holidays and public holidays as specified in the Contractor's Conditions of Contract.

5 STORAGE

5.1 The Contractor shall provide adequate and safe storage for all materials. All materials shall be stored or stacked in positions that will not interfere with other work in progress in the area.

6 QUALITY OF MATERIALS

6.1 All materials supplied or utilised under this Contract shall be new and unused. Only materials of first class quality and finish shall be utilised. All materials shall be subject to prior approval by the Engineer.

6.2 All materials shall comply with the relevant SABS and/or banking industry specifications.

6.3 All materials shall be unconditionally guaranteed for a period of 12 months from the date of practical completion, which is first hand over. Where Supplier's guarantees are of a shorter duration than 12 months, the Contractor shall unreservedly agree to the extension and cession of all warranties and guarantees.

6.4 The Contractor shall replace any materials that are found to be defective during the 12 months contractual defects liability period.

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7 COMPETENCE OF PERSONNEL, WORKMANSHIP AND STAFF

7.1 All work shall be executed and supervised by suitably qualified staff. Only "ACCREDITED PERSONS" shall be permitted to carry out and supervise work.

7.2 The Contractor shall at all times have an adequate number of employees available during the construction period to ensure that the work does not delay the construction programme.

7.3 The works shall be supervised by a full time Qualified Commissioning Engineer with at least ten years system integration experience. The CV of the Commissioning Engineer shall be submitted for scrutiny and approval by the Client or the Client's Representative. The abovementioned specialist shall be available for an interview with the Client should the need arises.

7.4 The Commissioning Engineer shall be responsible, inter alia, for:

- active involvement with equipment selection and procurement,
- scheduling and co-ordinating work to meet tight deadlines,
- verifying equipment and material Manufacturers specifications,
- ensuring compatibility of system components,
- ensuring that equipment interface and operate to specification,
- compiling network and equipment acceptance test procedures
- procurement of testing equipment and meters,
- investigating problems, troubleshooting, diagnosing/repairing faults,
- liaison with project engineers,
- supervising engineering and technical staff,
- writing reports and documentation,
- providing technical support,
- site QA, including installation snagging lists,
- managing compilation of as-built drawings and diagrams,
- ensuring safe working conditions,
- making improvements to and offering advice about operational procedures, and
- training maintenance and operative staff where appropriate.

8 CO-ORDINATION OF SERVICES

8.1 The Contractor shall be responsible for the on site co-ordination with the Principal Contractor and other sub-contractors. Due allowance shall be made for this liaison and on-site co-ordination in the tender price.

8.2 Continuous liaison with the electronic and electrical services contractors will be required as the electrical and electronic work will have to be done in the same enclosures.

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9 FINISHING AND TIDYING

9.1 In view of the concentration of construction and other activities likely to be experienced during the Contract period, progressive and systematic finishing and tidying will form an essential part of this Contract. On no account will soil, rubble, materials, equipment or unfinished operations be allowed to accumulate in such a manner as to unnecessarily impede the activities of others. In the event of this occurring the Employer will have the right to withhold payment for as long as may be necessary in respect of the relevant Works in the area(s) concerned, without thereby prejudicing the rights of others to institute claims against the Contractor on the ground of unnecessary obstruction.

9.2 Finishing and tidying shall therefore not be left to the end of the Contract, but shall be a continuous operation.

10 EXISTING WORKS AND SERVICES

10.1 The Contractor is responsible for obtaining information regarding services and the existing works which may be affected by the new works. Before the Contractor commences operations, he must discuss with and have the approval of the Project manager concerned regarding the method he proposes to use for the safeguarding of any services and existing works he may encounter during construction. The cost of all precautionary measures, which may be necessary to ensure the safety of such services and existing works, as well as the protection of all persons, shall be borne by the Contractor. Any alteration to services, which may be required, shall be carried out by the Authority concerned at the expense of the Contractor. The Contractor shall be held responsible for any damage, injury or accident caused as a result of his failure to take the necessary precautionary measures.

11 SUPERVISION

11.1 Work shall at all times be subject to full time supervision by a qualified and experienced Site Agent. This representative must be authorised and competent to receive instructions on behalf of the Contractor.

12 PROTECTION OF OTHER SERVICES AND STRUCTURES

12.1 The Contractor shall take all the necessary precautions to protect existing services, finishes and structures during the execution of the Contract, and shall be fully responsible for all repairs and damages thereto. The costs for any repairs of damages shall be recovered from the Contractor.

12.2 The Contractor shall also exercise extreme care when excavations are made, to avoid damage to existing or newly installed services. Any damages to other services shall be rectified forthwith and the costs for the rectification will therefore be recovered from the Contractor.

13 WORK BY OTHERS

13.1 Extensive on-site liaison between the different Contractors will be required as this is a fast track, multi-disciplinary project.

13.2 The bulk AFC System shall be supplied by this contract.

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14 EMV COMPLIANT DUAL INTERFACE CHIP CARDS

14.1 General

14.1.1 All EMV compliant chip cards shall conform to MasterCard Worldwide's or Visa International's specifications that support either MasterCard PayPass or Visa payWave for contactless payment transactions.

14.1.2 All EMV compliant cards shall conform to the relevant MasterCard Worldwide or Visa International Integrated Circuit Card specifications for pre-authorised debit

14.1.3 All EMV Compliant Dual Interface Chip Cards shall be EMV Level 1 certified.

14.1.4 All EMV Compliant Dual Interface Chip Cards shall be EMV Level 2 certified.

14.1.5 In order to issue a cost effective product, it will be preferred that the EEPROM (Electrical Erasable Programmable Read Only Memory) size should not exceed 12Kbyte; preferably 8Kbyte.

14.1.6 All MasterCard PayPass chip cards shall conform to/have:

14.1.6.1 MasterCard PayPass dual profile for both contactless and contact based transactions.

14.1.6.2 The M/Chip Select 4 risk management features will be configured for MPA (*MasterCard Pre-Authorised*) in order to enable offline contactless transactions.

14.1.6.3 The M/Chip Profile for MasterCard PayPass transactions only. The Mag Stripe Profile for PayPass transactions is not to be supported.

14.1.6.4 CDA (Combined Dynamic Data Authentication and Cryptogram) card authentication only, for contactless transactions.

14.1.6.5 CDA and DDA (Dynamic Data Authentication) card authentication for contact based transactions.

14.1.6.6 The MasterCard Card Compliance Assessment and Security Testing (CAST) program.

14.1.6.7 A MasterCard PayPass Vendor product – Letter of approval. Please quote the approval identifier in the letter of approval. Also quote the expiry date of the current certification. If the expiry date is soon, then please specify the planned extension.

14.1.7 All Visa payWave dual interface cards shall conform to/have:

14.1.7.1 Visa's Prepaid Chip specification for both contactless and contact based transactions. The latter specification builds upon and extends the functionality of VIS (Visa Integrated Circuit Card Specification) and VCPS (Visa contactless Payment Specifications).

14.1.7.2 The application must support qVSDC (quick Visa Smart Debit Credit) for contactless based transactions. The MSD (Magnetic Stripe Data) profile is not to be supported.

14.1.7.3 Visa approval for the chip card product. Please quote 'Visa approval reference number'. Also quote the expiry dated of the current certification. If the expiry date is soon, then please specify the planned extension.

14.1.8 All EMV Complaint Dual Interface Chip Cards shall have the National Department of Transport's AFC Data Structure.

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14.1.9 All EMV Complaint Dual Interface Chip Cards shall be stored in an inactive state, activation shall only be effected by a process implemented by the Issuing Bank.

14.1.10 All EMV Complaint Dual Interface Chip Cards shall have a Bank Identification Number (BIN) and Primary Account Number (PAN) displayed on the primary face of the card at issuance.

14.1.11 All EMV Compliant Dual Interface Chip Cards shall be of a PVC plastic card body type. Proposals for other card body types are encouraged but will require the approval of the Engineer before acceptance.

14.1.12 All EMV Compliant Dual Interface Chip Cards shall have a high-coercivity (HiCo) premium flush magnetic stripe.

14.1.13 All EMV Compliant Dual Interface Chip Cards shall have a Card Association (MasterCard or Visa) compliant signature panel.

14.1.14 All EMV Compliant Dual Interface Chip Cards shall have a Card Association (MasterCard or Visa) compliant hologram.

14.1.15 All EMV Compliant Dual Interface Chip Cards' printing shall be done on the front and back by approximately 6 Litho colours. The front shall include the logo of the corresponding Card Association (MasterCard or Visa), as well as the Card Association's technology branding (PayPass or payWave). Strict compliance to the corresponding Card Association's branding should be adhered to.

15 EMV POINT-OF-SALE TERMINALS (AT IRT KIOSK)

15.1 General

15.1.1 These point of sale (POS) terminals need a contact interface that will be used to:

15.1.1.1 Load value to the chip card for 'MasterCard Pre-Authorised' or 'Visa Prepaid' by acceptance of cash utilising processes implanted by the Issuing Bank.

15.1.1.2 Load value to the chip card for 'MasterCard Pre-Authorised' or 'Visa Prepaid' by accepting another Visa or MasterCard credit or debit card as method of payment for the value loaded utilising processes implemented by the Issuing and Acquiring Bank.

15.1.1.3 Write 'transit ticket' data securely to the card with the EMV Issuer-to-Card Scripting Process to the Secure Fixed Frame as well as update the Secure Card Frame accordingly, against payment received.

15.1.1.4 Display the value and/or transit tickets loaded on the chip card.

15.1.2 All POS terminal functionality as specified in Section 15.1.1 above, must adhere to relevant requirements and rules of PASA and the card associations.

15.1.3 The POS terminal should ideally be integrated to the Kiosk Thin-Client (Terminal).

15.2 POS Compliance

15.2.1 All point of sale (POS) terminals shall have EMVCo Type Approval – Terminal Level 1.

15.2.2 All POS terminals shall have EMVCo Type Approval – Terminal Level 2.

15.2.3 All POS terminals must be certified as compliant by the relevant card association/s..

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15.2.4 All PEDs (PIN Entry Devices) on all terminals and vending machines must meet the PCI (Payment Card Industry) security requirements.

15.2.5 All POS Terminal/Host communication and storage of sensitive card data shall be PCI-DSS (Payment Card Industry – Data Security Standard) compliant.

15.3 Communications

15.3.1 In addition to any industry compliant communication interfaces all POS shall have a USB connection as primary communication.

15.4 POS Features

15.4.1 All POS terminals must have a backlit display with 4 lines of text as a minimum.

15.4.2 All POS terminals must have PIN entry device capability as per Section 15.2.4 above.

15.4.3 All POS terminals must have a full graphic thermal printer.

15.4.4 All POS terminals must have magnetic stripe and chip card capability.

15.4.5 All POS terminals must have sufficient memory to enable applications called for in this contract to be fit for purpose.

16 EMV CONTACTLESS CARD READERS (READER AT THE ACCESS GATES AND BUSSES)

16.1 General

16.1.1 The EMV Contactless card reader will be linked to the Fare Processor.

16.2 Card Reader

16.2.1 The contactless card reader must have a display to provide visual cues for the commuter regarding the ready state of the card reader and when to remove the card from the card reader radio frequency field. Audible cues should also guide the commuter as to when the transaction was successful or failed.

16.2.2 The card reader must give a visual indication by means of a contactless symbol where a commuter must tap their card to achieve a successful read.

16.3 Card Reader Interface

16.3.1 The EMV Contactless card reader must preferably be linked to the Fare Processor via a USB connection. Preferably the contactless reader should also be powered thru the USB connection avoiding multiple cables at the access point.

16.4 Card Reader Compliance

16.4.1 All card readers shall be EMV Level 1 certified.

16.4.2 All card readers shall be EMV Level 2 certified.

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16.4.3 All card readers shall be ISO 14443 Type A/B compliant.

16.4.4 All card readers shall be MasterCard PayPass and/or Visa payWave compliant.

16.4.4.1 It is mandatory that the PayPass M/Chip Reader Card Application Interface Specification Version 2.0, dated September 2008 are complied with and that the updates specified in the MasterCard PayPass – M/Chip Application Note #15, dated 2 April 2009 are implemented, regardless of future actual implementation date requirements quoted in subject documents.

16.4.4.2 All card readers during application selection must support partial AID (Application Identifier) matching.

16.4.4.3 The PayPass and Visa payWave readers must be implemented in "Intelligent mode". In other words the contactless reader handles the majority of contactless transaction processing, and only pass the result to the Fare Processor.

16.4.4.4 The Visa payWave reader must conform to the qVSDC (Quick Visa Smart Debit Credit) reader functionality specified in the Visa Contactless Payment Specification, version 2.0.2, dated July 2006, including the Additions and Clarifications 3.0, dated August 2007.

16.4.5 All card readers shall be PCI-DSS compliant.

16.5 Transaction Processing

16.5.1 All card readers shall support the National Department of Transport's AFC Data Structure. The data structure (refer to National department of Transport's AFC Data Structure for further information) will function as follows:

16.5.1.1 Allow the Fare Processor to establish if any Transit Products exists for the relevant transit operator.

16.5.1.2 Allow the Fare Processor to establish if any concessionary data is stored in the Secure Card Frame.

16.5.1.3 Allow Tap-On-Tap-Off information to be written to the data structure.

16.5.2 All card readers in addition to support for processing the transit data as specified in Section 16.5.1 above shall also be able to process a MasterCard PayPass or Visa payWave payment against pre-authorised debit value loaded on the card.

17 CARD VENDING MACHINES

17.1 General

17.1.1 All card vending machines (CVM) shall be able to issue an EMV Compliant Dual Interface Chip Card in compliance to MasterCard and Visa regulations for safekeeping of pre-paid cards.

17.1.2 All CVMs shall allow for activation and PIN change before the Chip Card is issued to the commuter.

17.1.3 All CVMs shall allow for coin and note receptacles.

17.1.4 All CVMs shall have the ability to provide change.

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17.1.5 The CVMs shall allow the commuter to change their own PIN (in other words a customer selected PIN). The initial issuance of the PIN is left to the discretion of the Issuing Bank.

17.1.6 All CVMs shall have the ability to provide a receipt through a printed receptacle.

17.1.7 All CVMs' Chip Card receptacle shall be of dual functionality to:

17.1.7.1 Issue printed receipts and,

17.1.7.2 Accept EMV contact Chip Cards, and

17.1.7.3 Accept Magstripe Debit and/or Credit bank based cards.

17.1.8 All CVMs shall adhere to the necessary Visa and MasterCard Card Association branding rules.

17.2 Chip Cards within Vending Machines

17.2.1 Chip Cards will l be stored in an inactive state in the CVM.

17.2.2 No Chip Card shall contain any pre-authorised or prepaid value when stored within the CVM in an inactive state.

17.2.3 No Chip Card shall have transit value loaded when stored within the CVM.

17.3 Interface

17.3.1 All CVM shall have an Ethernet connection as primary communication.

17.3.2 All CVM shall have a GPRS modem as secondary communication.

17.4 Transaction Processing

17.4.1 All CVMs shall allow the commuter to check the value loaded on the chip card or transit ticket (s) supported by the operator.

17.4.2 All CVMs shall allow the commuter to activate the chip card to be issued.

17.4.3 All CVMs shall allow the customer to select their own PIN (customer selected PIN) before card issuance by means of the EMV Issuer-to-Card Script Process described in Section 18. The initial issuance of the PIN is left to the discretion of the Contractor.

17.4.4 All CVMs shall allow the customer to Load value to the MasterCard Pre-Authorised or Visa Pre-Paid cards by means of the EMV Issuer-to-Card Script Process described in Section 18. Methods of payment will be same as described in Section 15.1.1.

17.5 Card Vending Machine Compliance

17.5.1 All Ticket vending machines shall be PCI-PED compliant.

17.5.2 All CVMs shall be PCI-DSS compliant.

17.5.3 All CVMs shall have EMVCo Type Approval – Terminal Level 1.

17.5.4 All CVMs shall have EMVCo Type Approval – Terminal Level 2.

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17.5.5 All CVMs need to undergo tests required for Visa and MasterCard certification when implementing a chip program, prior to deployment, such as the MasterCard Terminal Integration Process, MasterCard Network Interface Validation, Visa Acquirer Device Validation and required online tests.

18 EMV ISSUER-TO-CARD SCRIPT PROCESSING

18.1 General:

18.1.1 Transit data can be written to the Secure Card Frame and Secure Fixed Frames (refer to National department of Transport's AFC Data Structure for further information), only once a special write access has been fulfilled. Adherence to the latter write access condition on the chip card it is necessary to cryptographically secure the data transmission form the card issuer to the chip card, to prevent unauthorised manipulation of the transit data. This entails a process called EMV Issuer-to-Card Script Processing.

18.1.2 A PIN change will also require EMV Issuer-to-card Script Processing.

18.1.3 Loading of value to the MasterCard Pre-Authorised or Visa Pre-Paid cards will also require EMV Issuer-to-Card Script Processing.

18.1.4 Only a MasterCard or Visa member bank (or authorised member service provider), being a card issuer of MasterCard PayPass or Visa payWave cards, will be able to prepare issuer script commands to be delivered to the EMV compliant dual interface chip cards.

18.1.5 All EMV Issuer-to-Card Scripts shall not exceed 128 bytes in size.

18.1.6 All Issuer-to-Card Script processing shall adhere to the necessary PASA (Payment Association of South Africa) requirements and relevant card association rules.

18.2 Cryptographic Interaction

18.2.1 All cryptographic interaction is between the card issuer and the chip card..

18.3 Offline

18.3.1 No offline EMV Issuer-To-Card Script processing is possible. This is entirely an online process.

18.4 Online

18.4.1 All EMV Issuer-to-Card Script processing shall be online and will be a contact-based chip transaction. No Issuer-to-Card Script processing via the contactless interface will be allowed.

18.4.2 All EMV Issuer-to-Card Script enabled equipment (POS and CVM) shall have the ability to communicate through the provided communications channels to the Issuing Bank to facilitate Issuer-to-Card Script processing via interbank processes provided by the banking industry.

19 LABELLING OF EQUIPMENT

19.1 All EMV readers, point-of-sale, and vending machines shall be labelled with engraved labels on the mounting plate.

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20 INSPECTIONS

20.1 The Fare Systems Engineer's or Client's representative will inspect the installation at any time. All inferior, unsuitable, unacceptable or rejected work shall, if indicated by the inspecting officers or the Engineer, be removed and shall be rectified by the Fare Systems Contractor at his own expense. Under no circumstances will these inspections relieve the Fare Systems Contractor of his obligations in terms of the document nor will these inspections be regarded as final approval of the works or portions thereof.

20.2 Where, inspections are requested by the Contractor, the Fare Systems Engineer's or Client's inspection shall only be carried out after the Contractor has carried out his own preliminary inspection to ensure that the Works are completed and comply with the documents. The Fare Systems Engineer's or Client's inspection shall therefore not be regarded as supervision, fault listing, quality assurance or site management.

21 SITE TESTS AND COMMISSIONING

21.1 The following minimum site tests shall be carried out by the Contractor and the results presented to the Engineer:

21.1.1

22 CERTIFICATE OF COMPLIANCE TO PCI

22.1 All work covered under this contract or that has to be carried out on site, must be executed by a qualified and fully representative person. Only persons registered as an "installation technician" will be accepted to carry out the installation work. After completion of the contract, the Contractor shall submit to the Engineer a certificate of compliance in terms of the requirement as set out by the Payments Card Industry (PCI) standards prior to final payment being processed.

22.2 The Payments Card Industry (PCI) standards that needs to be submitted is:

22.2.1 The PCI – DSS Compliance Certificate

22.2.2 The PCI – PED Compliance Certificate

22.2.3 The PA – DSS Compliance Certificate

23 AS-BUILT DRAWINGS AND DOCUMENTATION

23.1 The Contractor shall prepare as-built drawings of his cable trenches, earthing cable layout as well as all the conduit routes.

24 12-MONTH DEFECTS LIABILITY PERIOD

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24.1 The equipment and installation supplied under this contract shall be guaranteed for a period of twelve months from date of acceptance by the Engineer in all respects and commissioned for continuous service. The tender price shall include for the above.

24.2 The defects liability will be for a period of twelve months, calculated from the date of issue of the Certificate of completion by the Engineer. Retention funds will be reduced to 5% upon the commencement of the defects liability period. The balance of the retention money will be paid out after the lapse of the defects liability, provided the installation has operated in a stable and satisfactory working order during this period.

24.3 The Contractor shall be responsible for the replacement of all missing draw wires and conduit accessories during the contractual 12 months defects liability period.

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ANNEXURE H:
AFC SYSTEM MAINTENANCE SERVICE LEVEL SPECIFICATIONS

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CITY OF CAPE TOWN IRT SYSTEM:
AFC SYSTEM MAINTENANCE SERVICE LEVEL SPECIFICATIONS

These Specifications form an integral part of and supplement the terms and conditions of the Main Contract.

1. DEFINITIONS AND INTERPRETATION

1.1 Definitions

In these Specifications the following words, expressions and abbreviations have the meanings assigned to them, except where the context requires otherwise:

1.1.1 "ADSL" means Asynchronous Digital Subscriber Line;

1.1.2 "AFC" means Automated Fare Collection;

1.1.3 "AFC Equipment" means –

1.1.3.1 the AFC equipment installed in the IRT Stations, consisting of EMV CVMs, IP phones, commuter gates, fare media printers, laser printers, points of sale, work stations, personalisation cameras, switches, UPS circuit breakers, work station circuit breakers, rack circuit breakers, commuter gate circuit breakers; CVM circuit breakers, main switches and over voltage protection modules;

1.1.3.2 the AFC equipment installed in the TMC, consisting of a 10 gigabit Ethernet intelligent switch, gigabit Ethernet switches, fare media printers, laser printers and work stations;

1.1.4 "AFC Hardware" means –

1.1.4.1 the AFC hardware installed in the IRT Stations, consisting of EMV readers, fare processors, UPS rack mounts, fare and communication servers and 3G/GPRS modems;

1.1.4.2 the AFC Hardware installed in the TMC, consisting of a leased-line modem (bank), an ADSL modem (internet), a network firewall, an application firewall, an EMV gateway server, an ATPMS gateway, a domain controller, a database server, a speed stile fare server, a vehicle fare server, a transit product server and a website server;

1.1.5 "AFC Software" means the software installed in any of the AFC Hardware;

1.1.6 "APTMS" means Advanced Public Transport Management System;

1.1.7 "Business Day" means any day other than a Saturday, Sunday or official public holiday in the Republic of South Africa;

1.1.8 "Business Hours" means the hours of 08:00 to 17:00 on Business Days;

1.1.9 "CVM" means Card Vending Machine;

1.1.10 "Daylight Hours" means the hours of 08:00 to 17:00 on Saturdays, Sundays and official public holidays in the Republic of South Africa;

1.1.11 "Emergency Maintenance" means Maintenance performed in response to an unexpected failure, damage or fault that requires immediate action;

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1.1.12 "EMV", in addition to the meaning assigned to it in the Requirements, means the Integrated Circuit Card Specifications for chip-based payment cards and point of sale (POS) acceptance devices;

1.1.13 "*Force Majeure*", for the purposes of these Specifications, means any event or circumstance, or combination of events or circumstances, beyond the reasonable control of the AFC System Contractor occurring on or after the Services Commencement Date, that materially adversely affects the performance by the AFC System Contractor of, or compliance with, its obligations under or pursuant to these Specifications, if such materially adverse effect could not have been prevented by the AFC System Contractor through the exercise of diligence and reasonable care, and includes –

1.1.13.1 acts of God, such as fires, floods, tidal waves, droughts, earthquakes, lightning, hurricanes, storms and other natural disasters;

1.1.13.2 government action not specific to these Specifications, including the failure by any responsible authority to carry out works or provide services, which causes the AFC System Contractor to be unable to perform or comply with all or a material part of its obligations under these Specifications;

1.1.13.3 failure or shortage of power, fuel or transport;

1.1.13.4 riots, explosions, insurrection, war, sabotage, armed conflicts and acts of terrorism;

1.1.13.5 nuclear, chemical or biological contamination; and

1.1.13.6 pressure waves caused by devices travelling at supersonic speed,

but excludes any lack of financial, human or technical resources;

1.1.14 "Good Industry Practice", in relation to the manner in which the Services are provided, means standards, practices, methods and procedures conforming to applicable law and manufacturers' specifications and exercising that degree of skill, care, diligence, prudence and foresight that would reasonably and ordinarily be expected from a skilled or experienced person engaged in a similar type of undertaking in similar circumstances;

1.1.15 "IP" means Internet Protocol;

1.1.16 "IRT" means Integrated Rapid Transit;

1.1.17 "IRT Operator" means the service provider contracted by the City of Cape Town to operate the IRT fare system;

1.1.18 "Main Contract" means the contract document for the design, supply, delivery, installation, testing and commissioning of the IRT fare system, the supply and distribution of fare cards, and the provision of maintenance and other related services;

1.1.19 "Maintenance" means activities of a repetitive, recurring nature, which are performed safely, effectively and efficiently to fulfil the purpose for which the System is used and to keep the System in the condition of functionality, within reasonable limits, for which it was initially intended within its normal

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expected life span and includes Preventative Maintenance and Emergency Maintenance, and "Maintain" has a similar meaning;

1.1.20 "Node" means local System Devices associated with a single IRT Station;

1.1.21 "Preventative Maintenance" means Maintenance performed at regularly scheduled intervals for the upkeep of the System, including without limitation, checking, testing and inspecting, recordkeeping, cleaning and periodic replacement when called for in the preventative maintenance schedule;

1.1.22 "Requirements" means the Requirements for the Implementation of Automated Fare Collection Systems prescribed in terms of the National Land Transport Transition Act, 2000 (Act No. 22 of 2000);

1.1.23 "Service Level" means the level according to which the Services are to be provided, as set out in these Specifications;

1.1.24 "Services" means the provision of Maintenance services as set out in these Specifications;

1.1.25 "System" means the AFC System, consisting of the System Devices installed in forty-six (46) different IRT Stations;

1.1.26 "System Device" means AFC Equipment, AFC Hardware or AFC Software, as the case may be;

1.1.27 "TMC" means the Transport Management Centre;

1.1.28 "UPS" means Uninterruptible Power Supply.

1.2 Interpretation

1.2.1 References to any responsible authority or any public or professional organisation include a reference to any of its successors or any organisation or entity, which takes over its functions or responsibilities.

1.2.2 References to clauses and sub-clauses are references to the clauses and sub-clauses of these Specifications.

1.2.3 The headings of clauses and sub-clauses are included for convenience only and do not affect the interpretation of these Specifications.

1.2.4 The AFC System Contractor acknowledges that it had the opportunity to take legal advice concerning these Specifications, and agrees that no provision or word used in these Specifications may be interpreted to the disadvantage of the IRT Operator because the IRT Operator was responsible for or participated in the preparation or drafting of these Specifications or any part of it.

1.2.5 References to "these Specifications" include these Specifications as amended in writing from time to time.

1.2.6 General words preceded by words such as "other" or "including" or "particularly" may not be given a restrictive meaning because they are preceded or followed by particular examples intended to fall within the meaning of the general words.

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2. OBJECTIVE

The key objective of these Specifications is to maintain optimum network management capacity of the System to assist the IRT operator in ensuring AFC through the most economic and effective utilisation of human and other resources.

3. SERVICES

3.1 Preventative Maintenance

3.1.1 The AFC System Contractor undertakes to Maintain the System Devices so as to ensure that the following Service Levels are met:

Description	Service Level
Maintenance of the System Devices to ensure uninterrupted operation twenty-four (24) hours a day, seven (7) days of the week. This Service Level is measured over a calendar month. Should any part of the System malfunction with the result that any one Node is affected by the malfunction, a penalty deduction as stated below will apply per node failure for as long as the malfunction occurs.	Ninety-nine percent (99%)
Maintenance of System Devices to ensure that each Node is available and operational. Availability is measured as the percentage of time (excluding Preventative Maintenance downtime) in a calendar month that the Node is operative.	Ninety-nine percent (99%)
Preventative Maintenance of System Devices.	Four (4) hours per Node per month
System Maintenance in TMC (on Business Days, Mondays to Fridays, during Business Hours):	
AFC Equipment	
Check operation of 10 gigabit Ethernet intelligent switch	One hundred percent (100%) weekly
Check operation of gigabit Ethernet switches	One hundred percent (100%) once every two (2) weeks
Verify operation of fare media printers	One hundred percent (100%) weekly
Service fare media printers	One hundred percent (100%) weekly
Verify operation of laser printers	One hundred percent (100%) weekly
Service laser printers	One hundred percent (100%) weekly
Verify operation of work stations	One hundred percent (100%) weekly
AFC Hardware	
Verify operation of leased-line modem (bank)	One hundred percent (100%) weekly
Verify operation of ADSL modem (internet)	One hundred percent (100%) weekly
Update, debug network firewall	One hundred percent (100%) monthly
Update, debug application firewall	One hundred percent (100%) monthly

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Verify operation of EMV gateway server	On e hundred percent (100%) weekly
Verify operation of ATPMS gateway	One hundred percent (100%) weekly
Verify operation of domain controller	One hundred percent (100%) weekly
System Maintenance in TMC (on Business Days, Mondays to Fridays, during Business Hours):	
AFC Hardware	
Verify operation of database server	One hundred percent (100%) weekly
Verify operation of commuter gate fare server	One hundred percent (100%) weekly
Verify operation of vehicle fare server	One hundred percent (100%) weekly
Verify operation of transit product server	One hundred percent (100%) weekly
Verify operation of website server	One hundred percent (100%) weekly
AFC Software	
Network firewall software update, extract activity report	One hundred percent (100%) monthly
Application firewall software update, extract activity report	One hundred percent (100%) monthly
Domain controller software update, extract activity report	One hundred percent (100%) monthly
System Maintenance in IRT Stations (on Business Days, Mondays to Fridays, during Business Hours):	
AFC Equipment	
Verify operation of EMV CVMs	One hundred percent (100%) weekly
Verify operation of IP phones	One hundred percent (100%) weekly
Verify operation of commuter gates	One hundred percent (100%) daily
Service commuter gates	One hundred percent (100%) once every three days
Verify operation of fare media printers	One hundred percent (100%) weekly
Verify operation of laser printers	One hundred percent (100%) weekly
Verify operation of points of sale	One hundred percent (100%) weekly
Verify operation of work stations	One hundred percent (100%) weekly
Check/Test personalisation cameras	One hundred percent (100%) weekly
Verify health of over voltage protection modules	One hundred percent (100%) monthly
AFC Hardware	
Verify operation of EMV readers	One hundred percent (100%) daily
Verify operation of fare processors	One hundred percent (100%) daily

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Verify operation of UPS rack mounts	One hundred percent (100%) weekly
Verify operation of fare and communication servers	One hundred percent (100%) weekly
Verify operation of 3G/GPRS modems	One hundred percent (100%) weekly
System Maintenance in IRT Stations (on Business Days, Mondays to Fridays, during Business Hours):	
AFC Software	
Check, update fare processor software	One hundred percent (100%) weekly
Check, update fare and communications server software	One hundred percent (100%) weekly

3.1.2 A monthly Preventative Maintenance schedule must be logged with the IRT Operations Manager in the TMC at least seven (7) days before the first day of each month to ensure that the IRT Operations Manager is properly notified of the planned activities.

3.1.3 The AFC System Contractor undertakes to limit downtime as a result of Preventative Maintenance activities during off-peak periods and to observe a maximum monthly downtime of four (4) hours per Node per month.

3.1.4 In the event of an incident occurring during the course of any pre-planned Preventative Maintenance, of which the IRT Operator has been made aware, the AFC System Contractor is not liable for any penalty deduction.

3.1.5 A penalty deduction of ten percent (10%) of the monthly Maintenance fee applies per Node failure per day.

3.2 Emergency Maintenance

3.2.1 The AFC System Contractor undertakes to provide a twenty-four (24) hour call out service so as to ensure that the following Service Levels are met:

System Devices in TMC covered by this level	**Condition**	**Service Level: Calls logged on Business Days, Mondays to Fridays, during Business Hours**
All System Devices	Critical – Failures seriously affecting the operational effectiveness of the TMC	Respond within 2 hours of receipt of call, investigate and restore or provide temporary service immediately. Resolution time: 2 hours
System Devices in TMC covered by this level	**Condition**	**Service Level: Calls logged on Business Days, Mondays to Fridays, outside Business Hours**
All System Devices	Critical – Failures seriously affecting the operational effectiveness of the TMC	Respond within 4 hours of receipt of call, investigate and restore or provide temporary service immediately. Resolution time: 2 hours

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System Devices in TMC covered by this level	Condition	Service Level: Calls logged on Saturdays, Sundays and official public holidays, during Daylight Hours
All System Devices	Critical – Failures seriously affecting the operational effectiveness of the TMC	Respond within 4 hours of receipt of call, investigate and restore or provide temporary service immediately. Resolution time: 4 hours
System Devices in TMC covered by this level	**Condition**	**Service Level: Calls logged on Saturdays, Sundays and official public holidays, outside Daylight Hours**
All System Devices	Critical – Failures seriously affecting the operational effectiveness of the TMC	Respond within 8 hours of receipt of call, investigate and restore or provide temporary service immediately. Resolution time: 4 hours
System Devices in IRT Stations covered by this level	**Condition**	**Service Level: Calls logged on Business Days, Mondays to Fridays, during Business Hours**
All System Devices	Critical – Failures seriously affecting the operational effectiveness of an IRT Station	Respond within 1 hour of receipt of call, investigate and restore or provide temporary service immediately. Resolution time: 2 hours
System Devices in IRT Stations covered by this level	**Condition**	**Service Level: Calls logged on Business Days, Mondays to Fridays, outside Business Hours**
All System Devices	Critical – Failures seriously affecting the operational effectiveness of an IRT Station	Respond within 1 hour of receipt of call, investigate and restore or provide temporary service immediately. Resolution time: 2 hours
System Devices in IRT Stations covered by this level	**Condition**	**Service Level: Calls logged on Saturdays, Sundays and official public holidays, during Daylight Hours**
All System Devices	Critical – Failures seriously affecting the operational effectiveness of an IRT Station	Respond within 2 hours of receipt of call, investigate and restore or provide temporary service immediately. Resolution time: 4 hours

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System Devices in IRT Stations covered by this level	Condition	Service Level: Calls logged on Saturdays, Sundays and official public holidays, outside Daylight Hours
All System Devices	Critical – Failures seriously affecting the operational effectiveness of an IRT Station	Respond within 2 hours of receipt of call, investigate and restore or provide temporary service immediately. Resolution time: 4 hours

3.2.2 Failure to meet the Service Levels mentioned in sub-clause 3.2.1 above, results in the following penalty deduction:

3.2.2.1 R2 000,00 per call response failure per day; and

3.2.2.2 R2 000,00 per call resolution failure per day.

3.3 General

3.3.1 The AFC System Contractor is, at its own cost and risk, solely responsible for ensuring that the Services are performed:

3.3.1.1 In accordance with Good Industry Practice;

3.3.1.2 in a manner that is not likely to cause death, injury to health or damage to property or the environment;

3.3.1.3 in a manner that is consistent with the IRT Operator discharging its business;

3.3.1.4 in compliance with all applicable laws; and

3.3.1.5 in accordance with these Specifications.

3.3.2 The AFC System Contractor must at its own cost and risk Maintain the System, or part thereof, at such times and in such manner –

3.3.2.1 as to ensure that it is, at all times, able to operate the System;

3.3.2.2 without limiting sub-clause 3.3.1 above, as would be required having regard to Good Industry Practice; and

3.3.2.3 as required by law.

4. *FORCE MAJEURE*

4.1 Subject to sub-clause 5.2 below, the AFC System Contractor is relieved from liability under these Specifications to the extent that by reason of an event of *Force Majeure* it is unable to perform all or a material part of its obligations under these Specifications.

4.2 Where the AFC System Contractor is, or claims to be, affected by an event of *Force Majeure* –

4.2.1 it must take all reasonable steps to mitigate the consequences of such an event upon the performance of its obligations under these Specifications, resume performance of its obligations affected by the event of *Force*

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Majeure as soon as practicable and use all reasonable endeavours to remedy its failure to perform; and

4.2.2 it is not relieved from liability under these Specifications to the extent that it is unable to perform, or has not in fact performed, its obligations under these Specifications due to its failure to comply with its obligations under sub-clause 5.2.1 above.

4.3 The AFC System Contractor must serve notice in writing on the IRT Operator within one (1) Business Day of it becoming aware of the relevant event of *Force Majeure*.

4.4 Such initial notice must give sufficient details to identify the particular event claimed to be an event of *Force Majeure*.

4.5 A subsequent notice in writing must be served by the AFC System Contractor on the IRT Operator within a further two (2) Business Days which must contain such relevant information relating to the failure to perform, or delay in performing, as is available, including without limitation the effect of the event of *Force Majeure* on the ability of the AFC System Contractor to perform, the action being taken in accordance with sub-clause 4.2.1 above, the date of the occurrence of the event of *Force Majeure* and an estimate of the period of time required to overcome its effects.

4.6 The AFC System Contractor must notify the IRT Operator as soon as the consequences of the event of *Force Majeure* have ceased and when performance of its obligations can be resumed.

4.7 If, following the issue of any notice referred to in sub-clause (5) above, the AFC System Contractor receives or becomes aware of any further information relating to the event of *Force Majeure* or any failure to perform, it must submit such further information to the IRT Operator as soon as reasonably possible.

4.8 During the continuation of any event of *Force Majeure*, the amount payable in respect of such period is reduced to an amount equivalent to an amount payable in respect of those Services actually provided by the AFC System Contractor to the IRT Operator during such period after taking account of the effects of such event of *Force Majeure*.

4.9 The AFC System Contractor's sole right to payment or otherwise in relation to the occurrence of an event of *Force Majeure* is as provided in this clause.

4.10 The AFC System Contractor and the IRT Operator may agree upon any modifications to these Specifications which may be equitable having regard to the nature of an event or events of *Force Majeure*.

5. PERFORMANCE PERIOD REPORTING

5.1 The AFC System Contractor must prepare the following performance period report for the relevant month, which details the extent of performance for the relevant month:

Preventative System Maintenance in TMC (on Business Days, Mondays to Fridays, during Business Hours)					
Activity	**Service Levels**	**Month 1**	**Month 2**	**Month 3**	**Month ...**
AFC Equipment					
Verify operation of 10 gigabit Ethernet intelligent switch	100 %	... %	… %	… %	… %

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Verify operation of gigabit Ethernet switches	100 %	… %	… %	… %	… %
Number of gigabit Ethernet switches verified		…	…	…	…
Verify operation of fare media printers	100 %	… %	… %	… %	… %
Number of fare media printers verified		…	…	…	…
Verify operation of laser printers	100 %	… %	… %	… %	… %
Service laser printers	100 %	… %	… %	… %	… %
Number of laser printers verified		…	…	…	…
Number of laser printers serviced		…	…	…	…
Verify operation of work stations	100 %	… %	… %	… %	… %
Number of work stations verified		…	…	…	…
AFC Hardware					
Verify operation of leased-line modem (bank)	100 %	… %	… %	… %	… %
Verify operation of ADSL modem (internet)	100 %	… %	… %	… %	… %
Update, debug network firewall	100 %	… %	… %	… %	… %
Update, debug application firewall	100 %	… %	… %	… %	… %
Verify operation of EMV gateway server	100 %	… %	… %	… %	… %
Verify operation of APTMS gateway	100 %	… %	… %	… %	… %
Verify operation of domain controller	100 %	… %	… %	… %	… %
Verify operation of database server	100 %	… %	… %	… %	… %
Verify operation of commuter gate fare server	100 %	… %	… %	… %	… %
Verify operation of vehicle fare server	100 %	… %	… %	… %	… %
Verify operation of transit product server	100 %	… %	… %	… %	… %
Verify operation of website server	100 %	… %	… %	… %	… %
AFC Software					
Network firewall software update, extract activity report	100 %	… %	… %	… %	… %
Application firewall software update, extract activity report	100 %	… %	… %	… %	… %
Domain controller software update, extract activity report	100 %	… %	… %	… %	… %

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Preventative System Maintenance in IRT Stations (on Business Days, Mondays to Fridays, during Business Hours)					
Activity	**Service Levels**	**Month 1**	**Month 2**	**Month 3**	**Month 4**
AFC Equipment					
Verify operation of EMV CVMs	100 %	… %	… %	… %	… %
Number of EMV CVMs verified		…	…	…	…
Verify operation of IP phones	100 %	… %	… %	… %	… %
Number of IP phones verified		…	…	…	…
Verify operation of commuter gates	100 %	… %	… %	… %	… %
Number of commuter gates verified		...	...	...	...
Preventative System Maintenance in IRT Stations (on Business Days, Mondays to Fridays, during Business Hours)					
Activity	**Service Levels**	**Month 1**	**Month 2**	**Month 3**	**Month 4**
AFC Equipment					
Service commuter gates	100 %	… %	… %	… %	… %
Number of commuter gates serviced		...	...	...	...
Verify operation of fare media printers	100 %	… %	… %	… %	… %
Number of fare media printers verified		...	...	...	...
Verify operation of laser printers	100 %	… %	… %	… %	… %
Number of laser printers verified		...	...	...	...
Verify operation of points of sale	100 %	… %	… %	… %	… %
Number of points of sale verified		...	...	...	...
Verify operation of work stations	100 %	… %	… %	… %	… %
Number of work stations verified		...	...	...	...
Check, test personalisation cameras	100 %	… %	… %	… %	… %
Number of personalisation cameras checked/tested		...	...	...	...
Verify health of over voltage protection modules	100 %	… %	… %	… %	… %
Number of over voltage protection modules verified		...	...	...	...
AFC Hardware					
Verify operation of EMV readers	100 %	… %	… %	… %	… %

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Number of EMV readers verified		…	…	…	…
Verify operation of fare processors	100 %	… %	… %	… %	… %
Number of fare processors verified		…	…	…	…
Verify operation of UPS rack mounts	100 %	… %	… %	… %	… %
Number of UPS rack mounts verified		…	…	…	…
Verify operation of fare and communication servers	100 %	… %	… %	… %	… %
Number of fare and communication servers verified		…	…	…	…
Verify operation of 3G/GPRS modems	100 %	… %	… %	… %	… %
Number of 3G/GPRS modems verified		…	…	…	…
Preventative System Maintenance in IRT Stations (on Business Days, Mondays to Fridays, during Business Hours)					
Activity	**Service Levels**	**Month 1**	**Month 2**	**Month 3**	**Month 4**
AFC Software					
Check, update fare processor software	100 %	… %	… %	… %	… %
Check, update fare and communications server software	100 %	… %	… %	… %	… %
Emergency System Maintenance in TMC (on Business Days, Mondays to Fridays, during Business Hours)					
Activity	**Service Levels**	**Month 1**	**Month 2**	**Month 3**	**Month 4**
All System Devices: Call response time	Two (2) hours	… %	… %	… %	… %
All System Devices: Call resolution time	Two (2) hours	… %	… %	… %	… %
Number of calls for support		…	…	…	…
Number of responses to calls for support		…	…	…	…
Emergency System Maintenance in TMC (on Business Days, Mondays to Fridays, outside Business Hours)					
Activity	**Service Levels**	**Month 1**	**Month 2**	**Month 3**	**Month 4**
All System Devices: Call response time	Four (4) hours	… %	… %	… %	… %
All System Devices: Call resolution time	Two (2) hours	… %	… %	… %	… %
Number of calls for support		…	…	…	…

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Number of responses to calls for support		…	…	…	…
Emergency System Maintenance in TMC (on Saturdays, Sundays and official public holidays, during Daylight Hours)					
Activity	**Service Levels**	**Month 1**	**Month 2**	**Month 3**	**Month 4**
All System Devices: Call response time	Four (4) hours	… %	… %	… %	… %
All System Devices: Call resolution time	Four (4) hours	… %	… %	… %	… %
Number of calls for support		…	…	…	…
Number of responses to calls for support		…	…	…	…
Emergency System Maintenance in TMC (on Saturdays, Sundays and official public holidays. outside Daylight Hours)					
Activity	**Service Levels**	**Month 1**	**Month 2**	**Month 3**	**Month 4**
All System Devices: Call response time	Eight (8) hours	… %	… %	… %	… %
All System Devices: Call resolution time	Four (4) hours	… %	… %	… %	… %
Number of calls for support		…	…	…	…
Number of responses to calls for support		…	…	…	…
Emergency System Maintenance in IRT Stations (on Business Days, Mondays to Fridays, during Business Hours)					
Activity	**Service Levels**	**Month 1**	**Month 2**	**Month 3**	**Month 4**
All System Devices: Call response time	One (1) hour	… %	… %	… %	… %
All System Devices: Call resolution time	Two (2) hours	… %	… %	… %	… %
Number of calls for support		…	…	…	…
Number of responses to calls for support		…	…	…	…
Emergency System Maintenance in IRT Stations (on Business Days, Mondays to Fridays, outside Business Hours)					
Activity	**Service Levels**	**Month 1**	**Month 2**	**Month 3**	**Month 4**
All System Devices: Call response time	One (1) hour	… %	… %	… %	… %
All System Devices: Call resolution time	Two (2) hours	… %	… %	… %	… %
Number of calls for support		…	…	…	…

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Number of responses to calls for support		…	…	…	…
Emergency System Maintenance in IRT Stations (on Saturdays, Sundays and official public holidays, during Daylight Hours)					
Activity	**Service Levels**	**Month 1**	**Month 2**	**Month 3**	**Month 4**
All System Devices: Call response time	One (1) hour	… %	… %	… %	… %
All System Devices: Call resolution time	Two (2) hours	… %	… %	… %	… %
Number of calls for support		…	…	…	…
Number of responses to calls for support		…	…	…	…
Emergency System Maintenance in IRT Stations (on Saturdays, Sundays and official public holidays. outside Daylight Hours)					
Activity	**Service Levels**	**Month 1**	**Month 2**	**Month 3**	**Month 4**
All System Devices: Call response time	Two (2) hours	… %	… %	… %	… %
All System Devices: Call resolution time	Four (4) hours	… %	… %	… %	… %
Number of calls for support		…	…	…	…
Number of responses to calls for support		…	…	…	…

5.2 The performance period report must clearly show the basis of calculation of the Maintenance fees payable and penalty deductions, if any.

5.3 The performance period report must accompany the relevant monthly invoice submitted to the IRT Operator.

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ANNEXURE I:
NDOT AFC DATA STRUCTURE

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transport

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Transport
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7 May 2009

TO WHOM IT MAY CONCERN

OFFICIAL RELEASE OF REVISION 1 OF THE AUTOMATED FARE COLLECTION DATA/FILE STRUCTURE

Dear Sir/Madam

In terms of section 5(6)(c) of the National Land Transport Transition Act, 2000 (Act No. 22 of 2000), the Minister of Transport has gazetted a draft Regulation for Automated/Electronic Fare Collection Systems in Public Transport in South Africa. The final version of the Regulation will be gazetted shortly.

The Final Regulation will require all Automated Fare Collection in public transport to utilise "Bank Issued Fare Media" which means a Participating Bank issued payment instrument based on EMV Specifications and conforming to the requirements of the AFC Data Structure.

The Automated Fare Collection Data Structure utilises specific tags on the EMV chip of *Bank Issued Fare Media* for electronically recording and retrieving public transport-related data. The DoT and the Payments Association of South Africa have agreed that all Pre-paid, contactless *Bank-issued fare media* will carry the AFC Data Structure.

In order to facilitate speedy implementation, the DoT is officially releasing Revision 1 (attached) of the AFC Data Structure for project developers to integrate in anticipation of

the final Regulation. The attached Revision 1 will be referred to in the final Regulation and is the product of widespread consultation and input from all relevant parties and we are confident that it provides a viable basis for achieving inter-operable fare media in public transport in South Africa.

The DoT will put in place a certification process for cards and terminals to certify the functionality of each project's implementation of the AFC Data Structure Revision 1.

More information on the certification process will follow in due course.

In the meantime, project developers can contact Dawie Joubert at dawie@techso.co.za for any technical queries related to the AFC Data Structure.

Sincerely

_____

Ibrahim Seedat
Director: Public Transport Strategy
National Department of Transport

APPENDIX D: DATA / FILE STRUCTURE – REVISION 1

Figure 1 depicts the logical structure to the data elements. The Secure Card Frame will hold card specific information, such as which version of the data structure is currently in use on the card, which other frames are also in use or available, by whom they are used, and where they are located. This Secure Card Frame will be loaded automatically at start-up in a Terminal File Record by a public transport smartcard proximity coupling device. After the Secure Card Frame has been retrieved the remaining Frames can be retrieved through location and platform independent identifiers within the Secure Card Frame. Seven (7) platform independent location identifiers are included within the Secure Card Frame, six (6) of those are made up of three sets of Value Frames. A Value Frame set consists of a single Fixed Frame and a single Variable Frame. A seventh Frame is for the Generic Variable Frame which will keep most of the Tap On / Tap Off information if required.

A Value Frame contains information regarding a specific Concession or Ticket that a commuter has procured on his/her card. Each Commuter can procure three (3) different Concessions or Tickets in the current proposed structure. A Fixed Frame holds Concession - / Ticket Specific Information that needs to be secured and the Variable Frame Contains Tap On / Tap Off related information. **Table 1** outlines each frame's requirements and the associated data elements, their size, and what they are used for.

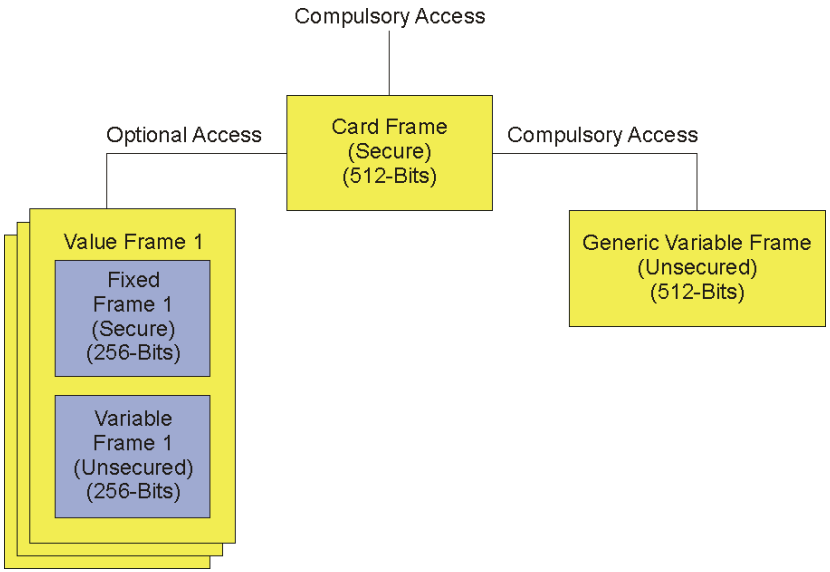


Figure 1: Logical Data Structure Layout

It should be noted that the three (3) Value Frames and their contents are not compulsory for a transaction and only contain information regarding a product that can be redeemed if the public transport services allows for such redemption (Monthly Tickets etc.). The Value Frame consists of two parts, a secured frame (Fixed) and an unsecured frame (Variable).

No	Parameter	Size (Bits)	Value Format	Description
	Secure Card Frame			
1	Frame Revision	8	BIN	Public Transport Data Structure Revision – Can be updated through a mutual PASA / NDOT agreement. (Currently Revision 0x01).
2	Value Frame Map	3	BITMAP	Each bit indicates which Fixed / Variable Frame are currently in use.
3	Commuter Class Map	13	BITMAP	Each bit will represent a type of commuter (disabled, elderly, scholar etc.) enabling possible future multiple commuter discounts. A commuter is required to provide Citizenship and ID fields when registering for concessions.
4	Commuter Citizenship	16	ASCII	ISO 3166 – 1 (alpha-2 ASCII) (If blank commuter is anonymous and regarded as unbanked or unregistered)
5	Commuter ID	48	BIN	Binary value corresponding to the National Identification/Insurance/Passport Number. (If blank commuter is anonymous and regarded as unbanked or unregistered).
6	Value Frame 1 Operator ID	96	See Table 5	Operator that has ownership of Value Frame 1. See Table 5
7	Value Frame 2 Operator ID	96	See Table 5	Operator that has ownership of Value Frame 2. See Table 5
8	Value Frame 3 Operator ID	96	See Table 5	Operator that has ownership of Value Frame 3. See Table 5
9	Secure Fixed Frame 1 Location	16	BIN	TAG / SFI Position. If SFI Usage is false, data holds Tag value. If Tag value is one byte, leading byte is zero. If SFI Usage is true, first byte holds SFI in most significant 5 bits with lower 3 bits set to '100'. Second byte contains record number.
10	Unsecure Variable Frame 1 Location	16	BIN	TAG / SFI Position. If SFI Usage is false, data holds Tag value. If Tag value is one byte, leading byte is zero. If SFI Usage is true, first byte holds SFI in most significant 5 bits with lower 3 bits set to '100'. Second byte contains record number.
11	Secure Fixed Frame 2 Location	16	BIN	TAG / SFI Position. If SFI Usage is false, data holds Tag value. If Tag value is one byte, leading byte is zero. If SFI Usage is true, first byte holds SFI in most significant 5 bits with lower 3 bits set to '100'. Second byte contains record number.
12	Unsecure Variable Frame 2 Location	16	BIN	TAG / SFI Position. If SFI Usage is false, data holds Tag value. If Tag value is one byte, leading byte is zero. If SFI Usage is true, first byte holds SFI in most significant 5 bits with lower 3 bits set to '100'. Second byte contains record number.
13	Secure Fixed Frame 3 Location	16	BIN	TAG / SFI Position. If SFI Usage is false, data holds Tag value. If Tag value is one byte, leading byte is zero. If SFI Usage is true, first byte holds SFI in most significant 5 bits with lower 3 bits set to '100'. Second

No	Parameter	Size (Bits)	Value Format	Description
				byte contains record number.
14	Unsecure Variable Frame 3 Location	16	BIN	TAG / SFI Position. If SFI Usage is false, data holds Tag value. If Tag value is one byte, leading byte is zero. If SFI Usage is true, first byte holds SFI in most significant 5 bits with lower 3 bits set to '100'. Second byte contains record number.
15	Unsecure Generic Variable Frame Location	16	BIN	TAG / SFI Position. If SFI Usage is false, data holds Tag value. If Tag value is one byte, leading byte is zero. If SFI Usage is true, first byte holds SFI in most significant 5 bits with lower 3 bits set to '100'. Second byte contains record number.
16	SFI Usage Map	8	BITMAP	Each bit indicates which Frame Location is currently True for SFI/Record Usage, else false for TAG usage (First bit (least significant bit) corresponds to item 9 within this list and the seventh bit corresponds to item 15). The last bit (most significant bit) must always be set to 0
17	Reserved for Future Use	16	N/A	Reserved for Future Use
	Secure Fixed Frame			
18	Product / Special Event ID	24	BIN	Type of Concession / Ticket this Frame will hold.
19	Product / Special Event Unique Instance ID	32	BIN	Unique instance ID of the product in question.
20	Start Date for Frame	24	BCD	09/01/28 (YY/MM/DD, without the “/”)
21	End Date for Frame	24	BCD	09/01/28 (YY/MM/DD, without the “/”)
22	Control Bits	16	BITMAP	Product specific bits (IFM product specific)
23	Reserved for Future Use	136	N/A	Reserved for Future Use
	Unsecure Variable Frame			
24	Control Bits	16	BITMAP	IFM product specific
25	Transaction Sequence ID	16	BIN	Transaction sequence possibility if multi-operator multi-modal is available for current frame.
26	Last Date Usage	24	BCD	09/01/28 (YY/MM/DD, without the “/”) When last was the product used.
27	Daily In Counter / Counter	12	BIN	Dual usage counter (6 bits counter, other 6 bits limit) or 12 bit Binary
28	Daily Out Counter / Counter	12	BIN	Dual usage counter (6 bits counter, other 6 bits limit) or 12 bit Binary
29	MAC	64	BIN	Message Authentication Code (MAC). Retail MAC / ISO 9797-1 Information Technology - Message Authentication Codes - MAC Algorithm 3 - Padding Method 2
30	Reserved for Future Use	112	N/A	Reserved for Future Use
	Unsecure Generic Variable Frame			
31	Boarding Date & Time	40	BCD	09/01/28.16:05 (YY/MM/DD.HH:MM, without the “/”,”.”, and “:”)
32	Boarding Location Type	2	BIN	0 = Informal, 1 = Bus/Taxi Stops, 2 = Facility, 3 = Route
33	Boarding Route ID / Facility ID	96	ASCII	See Table 2, Table 3, and Table 4 for the encodings associated with

No	Parameter	Size (Bits)	Value Format	Description
				Boarding Location Type.
34	Boarding GPS Longitude / Zone / KM	32	FLOAT	IEEE 754-1985 - Single Precision
35	Boarding GPS Latitude / Zone / KM	32	FLOAT	IEEE 754-1985 - Single Precision
36	Boarding Value Frame	2	BIN	Which Variable / Fixed Frame were used if any?
37	Boarding Control Bits	16	BITMAP	IFM product specific
38	Alighting Date & Time	40	BCD	09/01/28.16:05 (YY/MM/DD.HH:MM, without the "/",".", and ":")
39	Alighting Location Type	2	BIN	0 = Informal, 1 = Bus/Taxi Stops, 2 = Facility, 3 = Route
40	Alighting Route ID / Facility ID	96	ASCII	See Table 2, Table 3, and Table 4 for the encodings associated with Alighting Location Type.
41	Alighting GPS Longitude / Zone / KM	32	FLOAT	IEEE 754-1985 - Single Precision
42	Alighting GPS Latitude / Zone / KM	32	FLOAT	IEEE 754-1985 - Single Precision
43	Alighting Value Frame	2	BIN	Which Variable / Fixed Frame were used if any?
44	Alighting Control Bits	16	BITMAP	IFM product specific
45	MAC	64	BIN	Message Authentication Code (MAC). Retail MAC / ISO 9797-1 Information Technology - Message Authentication Codes - MAC Algorithm 3 - Padding Method 2
46	Reserved for Future Use	8	N/A	Reserved for Future Use

Table 1: Data Structure

The encoding of the transport routes, transport stops, and transport facilities are primarily based upon the South African National Land Transport Transition Act of 2000's encoding scheme of the concepts in question.

Data Element	Byte Position	Value Format	Description
Country	XXOOOOOOOOOO	ISO 3166 – 1 (alpha-2 ASCII)	South Africa = 'ZA'
Province	OOXXOOOOOOOO	ISO 3166 – 2 (subdivision code 2 characters in ASCII)	Gauteng = 'GP'
Municipality Type	OOOOXOOOOOOO	ASCII	(L)ocal, (D)istrict, and (M)etropolitan
Municipality	OOOOOXXOOOOO	BIN	0 - 65535
Stop Type	OOOOOOOXOOOO	ASCII	(F)ormal, and (I)nformal
Stop	OOOOOOOOXXOO	BIN	0 - 65535

Table 2: Coding of Public Transport Stops

Data Element	Byte Position	Value Format	Description
Country	XXOOOOOOOOOO	ISO 3166 – 1 (alpha-2 ASCII)	South Africa = 'ZA'
Province	OOXXOOOOOOOO	ISO 3166 – 2 (subdivision code 2 characters in ASCII)	Gauteng = 'GP'
Municipality Type	OOOOXOOOOOOO	ASCII	(L)ocal, (D)istrict, and (M)etropolitan
Municipality	OOOOOXXOOOOO	BIN	0 - 65535

Data Element	Byte Position	Value Format	Description
Facility Type	OOOOOOOXXOOO	ASCII	TR = Minibus-Taxi Rank TH = Minibus –Taxi Holding BT = Bus Terminal BD = Bus Depot BH = Bus Holding RS = Railway Station PR = Park & Ride MR = Metered Taxi Rank AP = Airport SP = Seaport
Facility	OOOOOOOOOXOO	BIN	0 - 255

Table 3: Coding of Public Transport Facilities

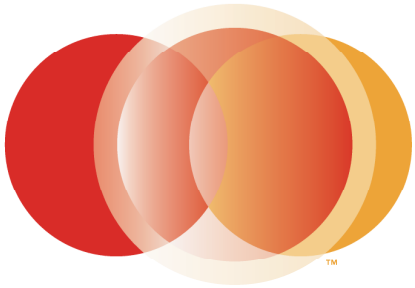
Data Element	Byte Position	Value Format	Description
Country	XXOOOOOOOOOO	ISO 3166 – 1 (alpha-2 ASCII)	South Africa = 'ZA'
Province	OOXXOOOOOOOO	ISO 3166 – 2 (subdivision code 2 characters in ASCII)	Gauteng = 'GP'
Municipality Type	OOOOXOOOOOOO	ASCII	(L)ocal, (D)istrict, and (M)etropolitan
Municipality	OOOOOXXOOOOO	BIN	0 - 65535
Route Direction	OOOOOOOXOOOO	ASCII	(I)ngoing, (O)utgoing, (F)orward, (R)eturn, (N)orth, (E)ast, (S)outh, or (W)est
Operator	OOOOOOOOXOOO	BIN	
Transport Type	OOOOOOOOOXOO	ASCII	(B)us, Minibus-(T)axi, (R)ail, (A)ir, and (S)ea
Route	OOOOOOOOOOXX	BIN	0 - 65535

Table 4: Coding of Public Transport Routes

Data Element	Byte Position	Value Format	Description
Country	XXOOOOOOOOOO	ISO 3166 – 1 (alpha-2 ASCII)	South Africa = 'ZA'
Province	OOXXOOOOOOOO	ISO 3166 – 2 (subdivision code 2 characters in ASCII)	Gauteng = 'GP'
Municipality Type	OOOOXOOOOOOO	ASCII	(L)ocal, (D)istrict, and (M)etropolitan
Municipality	OOOOOXXOOOOO	BIN	0 - 65535
Operator	OOOOOOOXXXXX	ASCII	Unique abbreviations

Table 5: Coding of Operator ID

APPENDIX E: DATA STRUCTURE – MASTERCARD PLATFORM



MasterCard
Worldwide

The following information is for reference purposes only. MasterCard Worldwide will provide detailed technical information at the signing of relevant Non-Disclosure Agreement between interested parties and themselves.

COMMANDS

The transit application data will be stored in data objects and/or files. Access to the transit data will be through:

1. GET DATA or PUT DATA commands which respectively read data from data objects and write data to data objects; or
2. READ RECORD or UPDATE RECORD commands using a SFI (Short File Identifier) & Record reference. Typically the content of the record itself will consist of data object(s).

A reference to the above four commands can be found in the following specifications:

1. SABS ISO/IEC 7816-4:1995 or later edition(s), and
2. The M/Chip 4 Version 1.1 Card Application Specifications for Debit and Credit, dated October 2006.

DATA OBJECT – BER-TLV STRUCTURE

As defined in ISO/IEC 8825 a BER-TLV (Basic Encoding Rules – Tag Length Value) data object consists of three parts:

- A tag uniquely identifies a data object within the environment of an application;
- The length is the length of the value field of the data object; and
- The value of the data object will consist of a data element.

STORAGE OF TRANSIT DATA

Storage of Secure Card Frame

The Secure Card Frame will always be referenced by Tag 9F6B (for local South African conditions, internationally accepted Tag would require MasterCard to provide an available Tag for use). Tag 9F6B (or international tag) will be exactly 64 bytes in length. Further Tag or SFI/Record references within the value part of Tag 9F6B (or international Tag) are Issuer dependent. The fields in the

Secure Card Frame as shown in the following two tables will contain either a 2byte Tag reference or a 2 byte SFI/Record combination.

For example, a Secure Card Frame (which is discussed later) containing Tag references:

Field Name	Bit Size	Type	Value
Frame Revision	8	Binary	01_{16}
Value Frame Map	3	BITMAP	
Commuter Class Map	13	BITMAP	
Commuter Citizenship	16	ASCII	
Commuter ID	48	Binary	
Value Frame 1 Operator ID	96	ASCII	
Value Frame 2 Operator ID	96	ASCII	
Value Frame 3 Operator ID	96	ASCII	
Secure Fixed Frame 1 location	16	Binary	$9F70_{16}$
Unsecure Variable Frame 1 location	16	Binary	9F75
Secure Fixed Frame 2 location	16	Binary	$9F71_{16}$
Unsecure Variable Frame 2 location	16	Binary	9F76
Secure Fixed Frame 3 location	16	Binary	$9F72_{16}$
Unsecure Variable Frame 3 location	16	Binary	$9F77_{16}$
Unsecure Generic Variable Frame	16	Binary	$9F78_{16}$
SFI usage map	8	Boolean	00000000_2
RFU (Reserved for Future Use)	16	N/A	

Table 6: MasterCard Secure Card Frame containing Tag references – Example

For example, a Secure Card Frame (which is discussed later) containing SFI/Record references:

Field Name	Bit Size	Type	Value
Frame Revision	8	Binary	01_{16}
Value Frame Map	3	BITMAP	
Commuter Class Map	13	BITMAP	
Commuter Citizenship	16	ASCII	
Commuter ID	48	Binary	
Value Frame 1 Operator ID	96	ASCII	
Value Frame 2 Operator ID	96	ASCII	
Value Frame 3 Operator ID	96	ASCII	
Secure Fixed Frame 1 location	16	Binary	$01AC_{16}$
Unsecure Variable Frame 1 location	16	Binary	$01B4_{16}$
Secure Fixed Frame 2 location	16	Binary	$02AC_{16}$
Unsecure Variable Frame 2 location	16	Binary	$02B4_{16}$
Secure Fixed Frame 3 location	16	Binary	$03AC_{16}$

Field Name	Bit Size	Type	Value
Unsecure Variable Frame 3 location	16	Binary	$03B4_{16}$
Unsecure Generic Variable Frame	16	Binary	$04B4_{16}$
SFI usage	8	Boolean	01111111_2
RFU (Reserved for Future Use)	16	N/A	

Table 7: MasterCard - Secure Card Frame containing SFI/Record references – Example

The value $01AC_{16}$ (hexadecimal) equates to 0000 0001 1010 1100_2 (binary). The binary value, from left to right, contains:

- $0000\ 0001_2$ = the record number; record number 1 in this example.
- 10101_2 (most significant 5 bits of 2nd Byte) = SFI 21.
- 100_2 (least significant 3 bits of 2nd Byte) = Indicates that the record number is stored in the 1st Byte.

Storage of Secure Fixed Frame

- Provision is made for three (3) Secure Fixed Frames.
- Each Secure Fixed Frame will be exactly 32 bytes in length.
- Each Secure Fixed Frame will be stored under its own Tag or SFI/Record combination.
- Each Issuer need to select their own Tag or SFI/Record combination references. These references need to be stored in the Secure Card Frame.
- The Secure Fixed Frame will require Secure Messaging to allow update in an online contact environment. No additional security measures are required from the Transport industry for this Frame.

Storage of Unsecure Generic Variable Frame

- Provision is made for one (1) Unsecure Generic Variable Frame.
- The Unsecure Generic Variable Frame will be exactly 64 bytes in length.
- The Unsecure Generic Variable Frame Each will be stored under a Tag or SFI/Record combination.
- Each Issuer need to select their own Tag or SFI/Record combination reference. This reference needs to be stored in the Secure Card Frame.
- The Unsecure Generic Variable Frame will not require Secure Messaging, and thus will be allowed to be modified in an offline contactless environment. The provision of a Transport MAC will be allowed for this Frame, but are not supplied by the Card Association.

Storage of Unsecure Variable Frame

- Provision is made for three (3) Unsecure Variable Frames.
- Each Unsecure Variable Frame is exactly 32 bytes in length.
- Each Unsecure Variable Frame will be stored under its own Tag or SFI/Record combination.
- Each Issuer need to select their own Tag or SFI/Record combination reference. This reference needs to be stored in the Secure Card Frame.
- The Unsecure Variable Frames will not require Secure Messaging, and thus will be allowed to be modified in an offline contactless environment. The provision of a Transport MAC will be allowed for each Frame, but are not supplied by the Card Association.

READING OF TRANSIT DATA

Secure Card Frame

Free read access (non-secure) through the use of a READ RECORD command. It is suggested that the Tag 9F6B (for local South African conditions, internationally accepted Tag would require MasterCard to provide an available Tag for use) be stored in one of the SFIs 1 through 10, and ensure that the SFI/Record combination is included in the contactless application's application file

locator. This will enable the Secure Card Frame to be read along with the remainder of the EMV Tags required for terminal risk management and action analysis.

Secure Fixed Frames

- Free read access (non-secure) through the use of either a GET DATA or READ RECORD command.
- Actual Tag or SFI/Record references will be stored in the Secure Card Frame.

Unsecure Generic Variable Frame

- Free read access (non-secure) through the use of either a GET DATA or READ RECORD command.
- Actual Tag or SFI/Record references will be stored in the Secure Card Frame.

Unsecure Variable Frame

- Free read access (non-secure) through the use of either a GET DATA or READ RECORD command.
- Actual Tag or SFI/Record references will be stored in the Secure Card Frame.

WRITING OF TRANSIT DATA

Access Protected Write (Secure):
Transit data can be written to Secure Card Frame, and Secure Fixed Frames, only once a special access condition had been fulfilled. For write access to Secure Fixed Frames, it is necessary to cryptographically secure the data transmission to the chip card to prevent unauthorised manipulation of the transit data. This sort of security for chip cards is called Secure Messaging. It involves adding a MAC (message authentication code) to each PUT DATA or UPDATE RECORD command. This requires knowledge of a session key between the card and the Issuing Bank's host system. Only the Issuing Bank has knowledge of the Master Keys. This process also requires an online transaction and will be a contact-based chip transaction.

Secure Card Frame

- Access protected write (secure) to Tag 9F6B (or international equivalent) through the use of an UPDATE RECORD command.

Secure Fixed Frames

- Access protected write (secure) through the use of either a PUT DATA or UPDATE RECORD command.
- Actual Tag or SFI/Record references will be stored in the Secure Card Frame.

Unsecure Generic Variable Frame

- Free write access (non-secure) through the use of either a PUT DATA or UPDATE RECORD command.
- Actual Tag or SFI/Record references will be stored in the Secure Card Frame.

Unsecure Variable Frame

- Free write access (non-secure) through the use of either a PUT DATA or UPDATE RECORD command.

Actual Tag or SFI/Record references will be stored in the Secure Card Frame.

Please contact MasterCard South Africa for more information.

APPENDIX F: DATA STRUCTURE – VISA PLATFORM

Please contact Visa South Africa for more information.

ANNEXURE J:
OPERATIONAL ROLE DESCRIPTIONS

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Part C4: Site information

Pages
C4 Site information C4-2

CITY OF CAPE TOWN

TRANSPORT ROADS & STORMWATER

CONTRACT NO. 24G/2009/10

DESIGN, SUPPLY, DELIVERY, INSTALLATION, TESTING, AND COMMISSIONING OF THE IRT FARE SYSTEM, THE SUPPLY AND DISTRIBUTION OF FARE CARDS, AND THE PROVISION OF MAINTENANCE AND OTHER RELATED SERVICES

C4 Site Information

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Part I: Background

1.1 Background and history of the project

The City of Cape Town's Integrated Development Plan has identified the improvement of public transport system and services as one of its eight key strategic focus areas to achieve the long term vision of the City and its developmental goals. Public transport plays a vital and essential role in providing the opportunity for all its citizens and visitors to access the full range of facilities which the City offers whether for work, education, recreation, health and social facilities. It is particularly important for the poorer sections of the community, who do not have access to private cars. It can provide mobility through safe, efficient and affordable public transport.

The City developed a Mobility Strategy aimed at "**Putting Public Transport, People and Quality of Life First"** to achieve it vision for public transport of a safe, effective, efficient, equitable and affordable public transport system that supports social and economic development in an environmentally responsible manner.
The realisation of this vision is for a full public transport network, encompassing high quality rail and road services, which will place at least 75% of Cape Town's population within 500 metres of the system.
In February 2007 the City did a scoping study for an integrated public transport network, and prepared a report entitled, "City of Cape Town – Public Transport Implementation Framework."

The report identified the potential for a network of Bus Rapid Transit (IRT) systems across the City to complement the existing rail system as part of an integrated public transport system. The concept for the IRT system was modelled on the highly successful projects implemented in a number of cities worldwide, including Beijing, Bogotá, Curitiba, Guayaquil, Los Angeles, Ottawa, Paris, Pereira, Quito, and Seoul.
In October 2007, the City formed a project office to undertake the development of an Integrated Rapid Transit (IRT) system in Cape Town. In early 2008, the City appointed experienced consultant teams to develop the Operations Plan and Business Plan for the system.

To finance the development and implementation of Phase 1A, the City has received a grant from National Government's Public Transport Infrastructure and Systems Fund (PTIS). This fund was established by the National Treasury to improve public transport country-wide in support of the hosting of the 2010 FIFA World Cup, but with a clear focus for a lasting legacy of improved public transport. The projects initial Phase is to ensure that the City achieves a lasting legacy for improved public transport and at the same time meets the requirements for the 2010 Host City Transport Operations Plan.

On 27 August 2008, the City Council gave approval for the implementation of Phase 1A of the Integrated Rapid Transit System. Phase 1A includes the Inner City, airport services, and certain West Coast routes including Atlantis, Dunoon, and the Blaauwberg area. The City has set aside R 421 million of its own funding for Phase 1A.

1.2 Purpose of the document

Like many other developing countries, South Africa is in the process of restructuring and formalising its public transport system. The new National Land Transport Bill, currently before Parliament, requires publicly controlled integrated transport systems. It plans for cities to take greater control of planning, regulating, implementing and monitoring public transport services. The City of Cape Town is mandated by the South Africa Constitution and the existing transport legislation under the National Land Transport Transition Act (Act 22 of 2000) to plan and implement public transport within its geographical area of jurisdiction.

Therefore this project falls within the full authority and jurisdiction of the City of Cape Town.
The purposes of this document are:

1. firstly, and most importantly, to provide basic information to the affected minibus taxi industry and bus industry on what the creation of the Integrated Rapid Transit system means for them.
2. to provide information to potential partners on the proposed project and how they might become involved.
3. to set out the programme and milestones for the various interventions and investment in the project

1.3. Outline of the document

Part I provides an overview of the Integrated Rapid Transit System (IRT). The business structure and institutional arrangements are covered in Part II. Part III provides the necessary details of the Operational Plan.

1.4. City of Cape Town's vision

The City's Integrated Development Plan (IDP) spelt out a bold vision for the City:

- a prosperous City in which City Government creates an enabling environment for shared growth and economic development
- a City known for its effective and equitable service delivery
- a City that distinguishes itself as a well governed and effectively run administration.

The IDP recognised the vital and essential contribution of public transport to attaining this vision and identified public transport systems as one of the strategic focus areas, the directly interrelated ones being:

- Shared Economic Growth and Development
- Sustainable Urban Infrastructure and Services
- Public Transport Systems
- Integrated Human Settlements
- Safety and Security.

It is evident that improved public transport works together with and as an enabler for the other focus areas listed above.

"By using public transport, the City aims to create the maximum opportunities for all residents and visitors to enjoy the full social, economic and environmental opportunities that Cape Town has to offer. This means transforming and restructuring the public transport system to attract new users and benefit those who already use the system. The City needs to integrate land use and transport and to align planning processes and policies properly. Integrated transport corridors will be planned. Increased residential densities will provide the necessary thresholds to ensure a supportive environment for public transport."

Integrated Development Plan, 2008/09 Review

Under the strategic focus area of *public transport systems*, the IDP identified five objectives:

- **Objective 1: Single point of authority for transport**

  The intention is to establish a single point of authority for transport in the City to overcome the highly fragmented responsibilities across the three spheres of government

- **Objective 2: Improve public transport services and secure new investment in transport infrastructure**

  The principal mechanism by which the City will transform road based public transport is through Integrated Rapid Transit (IRT). This will deliver fast, comfortable, and cost effective urban mobility through rapid and frequent operations, supported by excellent marketing and customer service. A critical success factor is the creation of a new business structure to transform the existing bus and minibus industry into participants in the system of contracts with the City.

- **Objective 3: Increase the cumulative kilometres of critical routes with dedicated public transport lanes**

  The City will plan and implement dedicated public transport lanes to provide for the fast, secure, and comfortable Bus Rapid Transit System. The level of enforcement will be enhanced.

- **Objective 4: Reduce average peak period travel time**

  The City will introduce Travel Demand Measures (TDM) to influence travel behaviour towards more sustainable transport options, such as higher vehicle occupancy, Park N Ride, ride-share, etc to reduce the number of trips, minimise travel time, and reduce congestion.

- **Objective 5: Promote non-motorised transport (NMT)**

  The City will plan and implement bicycle lanes, bicycle lock up facilities at key rail and bus terminals, and improve facilities for pedestrians.

1.5 Integrated transport plan

The City's Integrated Transport Plan (2006 – 2011) vision is to

'… provide a world-class sustainable transport system that moves all its people and goods effectively, efficiently, safely and affordably"

To achieve the City's transport vision, it has identified a number of strategic objectives, which overlap partly with the objectives of the IDP, set out above:

4. To strive towards a complete and balanced sustainable transport system.
5. To promote public transport over the private car.
6. To promote travel demand management measures to reduce total vehicle travel kilometres, especially during the commuter peak periods.
7. To align transport and land-use planning to positively influence commuter distances.
8. To promote and encourage non-motorised transport and universal access.
9. To promote and incorporate the principles of universal access in design and construction of transport facilities.
10. To provide a safe, efficient and well managed road network that enhances the efficiency of public transport.
11. To ensure an efficient and safe movement of freight within the City.

Public transport is the principle mechanism in realizing this bold journey towards a more balanced, sustainable transport system. The Integrated Transport Plan gives, inter alia, the following key thrusts of its Integrated Public Transport System:

- Development of rapid mass road-based public transport services on priority high volume corridors which are not served by rail, in support of an integrated network with rail.
- Development of a unified road-based scheduled service bringing the bus and taxi market into a unified service under contract using the appropriate vehicle size for financial and operational efficiencies.
- Introduction of an integrated fare management system.
- Development of the non motorized transport network to integrate with the rail and bus priority networks.
- Comprehensive passenger information system.
- Uniform branding of all public transport.
- Increased security on public transport.

Since the approval of the Integrated Transport Plan (2006 – 2011), the City put words to action by embarking on to process of transforming its public transport system towards an Integrated Rapid Transit Network.

In mid-2008, Council approved the inclusion of the Integrated Rapid Transit initiatives in more detail into the Integrated Transport Plan (2006 – 2011). Currently the Integrated Transport Plan is under review to account, amongst others, for further detail regarding the IRT initiatives and plans.

1.6. Overview of the existing public transport system in Cape Town

Based on surveys carried out by the City in 2004 for the Current Public Transport Record (CPTR), over 1.1 million passenger trips are made in the City of Cape Town on the three main modes of public transport: rail, bus and minibus-taxi as shown in Table 1.1. This excludes the other minor modes i.e. metered taxi, charters, long distance services etc. Rail accounts for 53%, bus 18%, and minibus-taxi 29% of the trips.

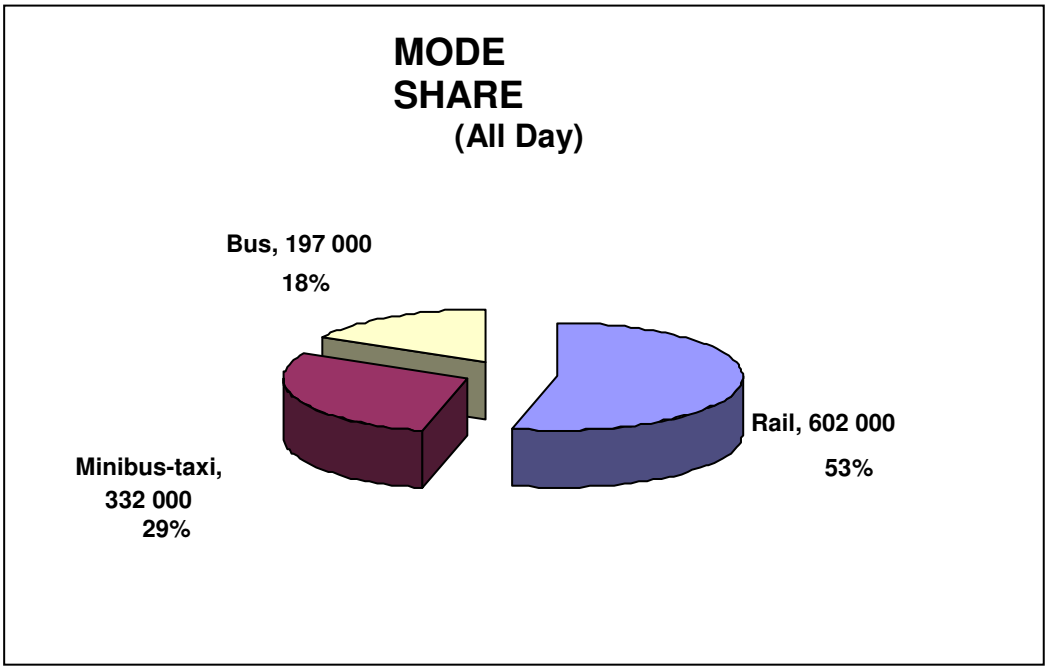
Since these surveys, the numbers of public transport users will have risen, with road based modes drawing some market share from rail due to certain existing deficiencies with the rail system, mainly the shortage of trains to meet the demand.

Table 1.1: Passenger trips per day

	PASSENGER TRIPS/DAY	%
Commuter Rail	601 940	53%

	PASSENGER TRIPS/DAY	%
Minibus-Taxi	332 410	29%
Bus	197 440	18%
TOTAL	**1 131 790**	**100%**

Source: CPTR 2004/05



Source: CPTR 2004/05

Cape Town has the advantage of an extensive rail network offering good coverage over large parts of the City. It penetrates extensive middle to high income areas as well as low income areas, and therefore has the potential to serve a wide range of travel markets. Currently the rail service conveys 632 360 passenger trips per day (2007 Rail Census Report).

The ability of the rail system to realise its full potential in delivering high quality service and expanding its market has been hampered by a long standing lack of investment over many years. Currently the system is operating at capacity on many lines and severe overcrowding occurs; it also faces other problems such as security concerns
The National Rail Plan and the Regional Rail Plan has identified priority corridors for rail investment including the upgrading and additions to the rolling stock, station upgrading, improved signalling, track improvements, as well as the extension to the Khayelitsha Line with two additional stations in the short term.

Subsidised scheduled bus services are provided by a single private company operating about 1000 buses under a contract with the Provincial Department of Transport, and is subsidised through a passenger subsidy from funds from the National Department of Transport.

Unscheduled services are provided by some 8000 minibus-taxis, with market entry regulated through the Province.
The major problems of the existing public transport system can be summarised as follows:

- lack of infrastructure to improve journey times through dedicated lanes
- underinvestment over many years, particularly in the rail system and to some extent in the bus sector, and bad quality of vehicles

- competition between the bus and taxi services for the same passengers on the same routes
- overtrading in the unscheduled minibus-taxi industry in certain areas giving rise to the potential for conflict and violence
- personal security concerns and perception of unsafe public transport
- lack of integration between services
- commuter oriented system with little off peak or extended day operations
- inappropriate positioning of modes in terms of vehicle size and capacity
- an uncertain investment climate for the bus sector, due to the fact that it is governed by an interim contract of uncertain duration
- inadequate enforcement
- absence of integrated ticketing systems.

1.7. Integrated Rapid Transit System

1.7.1. Design principles

The planning of the system is guided by a number of principles:

- **Quality –** delivering a car-competitive service that is based around customer needs, including rapid travel times and frequent services, few transfers, safety and security, service integration, universal access, comfort and convenience, clean vehicles, and helpful staff.
- **Equity –** ensuring that all segments of society receive and equal high-quality public transport experience, especially through consideration of the special needs of low income earners, women, children, the elderly, and those with physical disabilities.
- **Security –** a system which gives customers full confidence in their personal safety and security.
- **Sustainability –** a system that is sustainable in terms of economic viability, the environment, and social equity.
- **Integrity –** implementation in an open, transparent, and participatory manner

1.7.2. Main Features of the IRT System

The main features of the IRT system are summarised below (see chapter 3 for more detail regarding operational elements, such as the details regarding routes, the number of busses, etc, in Phase 1A).

Infrastructure

- segregated bus ways or bus-only roadways mainly in the middle lane of the roadway
- stations that are convenient, secure, and weather protected
- stations which provide level boarding between the platforms and the vehicle
- special stations that provide integration and convenient transfers between trunk routes, feeder routes and the rail system

Operations

- complete new fleet of modern vehicles
- frequent and rapid service
- rapid boarding and alighting
- pre-board fare collection, and pre board fare verification on trunk routes
- integrated fare system using smartcards
- improved pedestrian connections
- integrated pedicab and motorized three wheeler feeder services at select stations
- integrated bicycle rental at select stations
- secure bicycle parking at select stations
- improved facilities for non-motorised travel

Business and Institutional Structure

- reformed business model bringing in the existing bus and taxi operators with the City to provide the bus services
- transparent process for awarding contracts
- independent fare management system
- minimisation of public sector subsidies for the operations

Technology

- low emission, low noise vehicle technology
- automated fare collection
- intelligent Transportation System (ITS) management of operations and vehicle location
- signal priority for public transport at intersections

Marketing and Customer Service

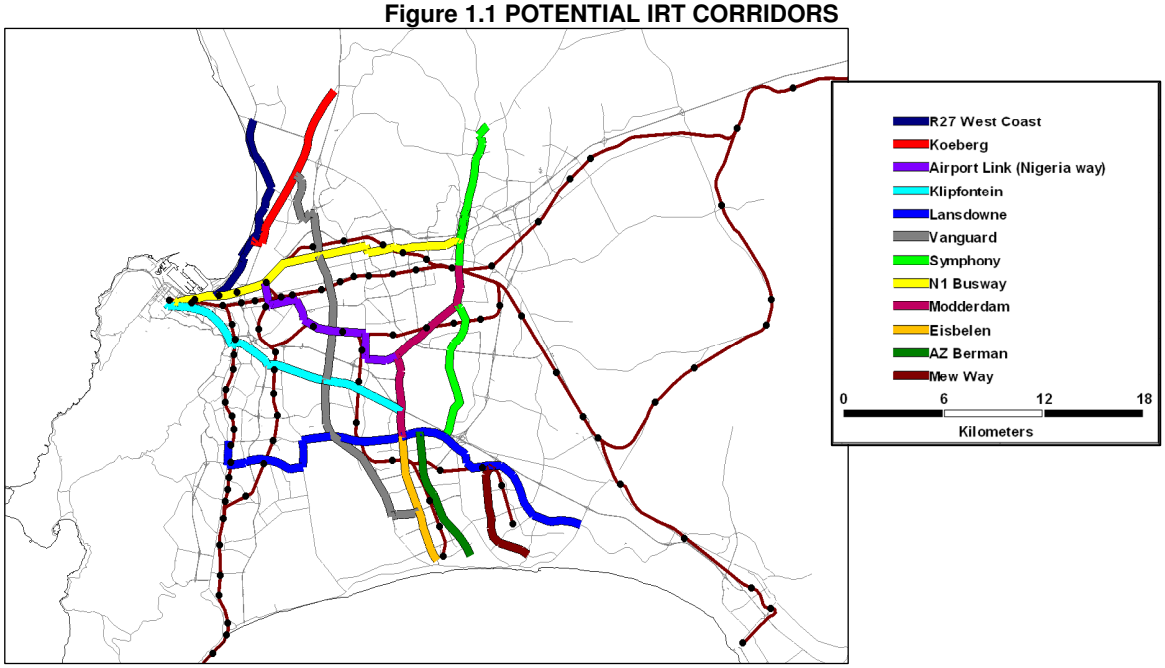
- distinctive identity
- excellence in customer service
- high standard passenger information at stations and vehicles
- good signage and maps
- special provisions for passengers with special needs

1.7.2. Phased implementation

The Operations Plan has identified the potential for rolling out the IRT concept across the City, and eventually bring all road based public transport into the IRT system. The plan is to establish the full network city-wide over the next 10 to 12 years as an integrated public transport system including the rail network.

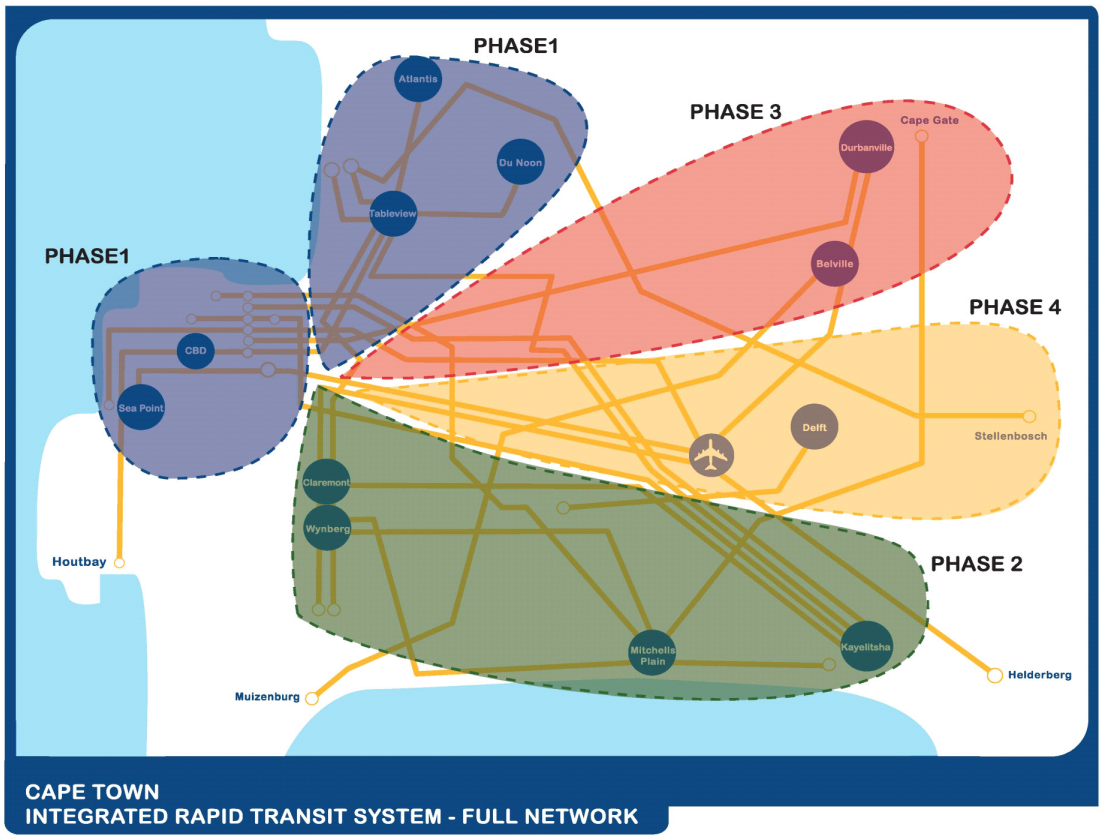
Figure 1.1 shows at a conceptual level the potential routes and corridors for implementing the IRT system. These will be evaluated further as the long term Operational Plan is developed and refined.

Figure 1.1 POTENTIAL IRT CORRIDORS



The full implementation of the project has been divided into 4 Phases. Phase 1 focuses on the central city and the west coast, which will then be followed in Phase 2 by the more pressing public transport needs of the metro south east, including Khayelitsha and Mitchells Plain. This will be followed by Phases 3 and 4 to include the Durbanville area and Delft respectively as shown in **Figure 1.2.**

Figure 1.2: PHASED IMPLEMENTATION



Phase 1 has been divided into four parts: Phase 1A, Phase 1A, Phase 1B and Phase 1C. Phase 1AA primarily public transport requirements of the 2010 FIFA World Cup, as provided in the Host City Transport Operations Plan, the requirements of the Host City Agreement signed with FIFA, the Record of Decision for the Green Point Stadium, and the Stadium Use Agreement, including a service from the Airport to the CBD.

Phase 1A includes the rest of the inner city and extending up the west coast to include the rapidly growing residential area in Blaauwberg, as well as the low-income communities of Atlantis, Mamre, Du Noon and Doornbach. This corridor faces some of the worst congestion levels in the City. The Council approval and allocation of funds is for Phase 1A.

1.8. National government support

National government, through the national Department of Transport, fully supports the IRT principles, and has engaged with the minibus taxi industry and Cities at a national level to set national guidelines to the process. Initiatives to establish IRT type services, including Bus Rapid Transit (BRT) systems, are underway throughout the country. These are highlighted in Figure 1.3 below.

Figure 1.3. IRT-type initiatives underway nationally

The cities that are first en route to implementation of the IRT are Johannesburg, Cape Town and Port Elizabeth.

1.9. Funding

Funding has been approved for Phase 1A of the project with a grant from the PTIS fund and contribution by the City of Cape Town. Table 1.2 shows the funding contributions for the Phase 1A of the project.

Table 1.2: Funding contribution for Phase 1A

Funding Source	2008/09 R million	2009/10 R million	2010/11 R million	Total R million
National Government (PTIS)				
Operating	46,13	22,00	0,00	68,13
Capital	383,94	448,75	0,00	832,69
Total	430,07	470,75	0,00	900,82
City of Cape Town				
Operating	0,00	15,38	30,75	46,13
Capital	226,91	148,10	0,00	375,01
Total	226,91	163,48	30,75	421,14
Total	**658,98**	**634,23**	**30,75**	**1 321,96**

A total of R 1,3 billion has been secured for Phase 1A, with R 900 million coming from the National Government and R 421 million from the City.

1.10. Infrastructure contracts

* Six contracts to the value of R 508 million (incl VAT) have already been concluded for the construction of the segregated bus ways, as indicated in the following table.

Table 1.3. Construction contracts awarded to date (as of 4 February 2009)

Contract	Contract Amount	Provision for Escalation	Total Provision
Culemborg: Old Marine Dr to Church St (Contract 144Q)	R 49 200 000	R 5 000 000	R 54 200 000
Culemborg: Church Street to N1 (Contract 27Q)	R82 200 000	R 15 000 000	R 97 200 000
Paarden Eiland: N1 to Milner Rd (Contract 77Q)	R 80 400 000	R 15 000 000	R 95 400 000
Paarden Eiland: Salt River Canal bridge (Contract 80Q)	R 16 000 000	R 2 000 000	R 18 000 000
R27: Milner Rd to Racecourse Rd (Contract 163Q)	R 130 400 000	R 17 000 000	R 147 400 000
R27: Racecourse Rd to Blaauwberg Rd (Contract 139 Q)	R 86 000 000	R 10 000 000	R 96 000 000
Total	**R 443 200 000**	**R 62 000 000**	**R 508 200 000**

Part II: Business structure of IRT system, and the contracting process

2.1. The business structure of the IRT System

There are six main role players in the City's anticipated Phase 1A of the IRT system:

- the City of Cape Town;
- possibly the Integrated Rapid Transit (IRT) Entity, a municipal entity that manages and controls the system;
- two vehicle operating companies;
- the fare system company;
- the control centre company; and
- the station services company.

This part of the Prospectus will outline the roles to be played by each of the above.

2.1.1. The City of Cape Town

The City of Cape Town ("the City") is constitutionally responsible for the provision of municipal public transport in the Cape Town metropolitan area.
During 2008, the City considered the issue of whether to carry out its public transport obligations internally (for example through one of its existing departments) or whether to set up an external mechanism (such as a municipal entity) to do so.

Before making this decision, the City is required to comply with two pieces of local government law, namely the Municipal Systems Act and the Municipal Finance Management Act. The City has complied with the requirements of the Municipal Systems Act, but – as at the date of issuing this draft Prospectus – has not yet complied with the requirements of the Municipal Finance Management Act.

In December 2008, the City decided, *subject* to the outcome of the assessment and public participation procedures prescribed by the Municipal Finance Management Act, to establish a municipal entity to provide (or manage the operations of) public transport-related functions on the City's behalf. The reasons for this decision includes that an entity should provide the commercial competence to manage and integrate the provision of the services, whilst the City would maintain effective control over the entity in terms of the Service Delivery Agreement.

The name of the entity is still under review. In this Prospectus it is assumed that this entity will be established, which is referred to as the Public Transport Entity.

Various initial contracts, including most of those described in this Prospectus, will initially be concluded by the City, but will be assigned to the Public Transport Entity through the SDA. In this agreement, the City will also assign to the Entity many of its other responsibilities in relation to the operations of the proposed IRT system. However, the City will remain responsible for the fulfilment of a number of functions in relation to the IRT system, including the construction of the IRT system infrastructure, roadway maintenance and cleaning, traffic signal control maintenance, property and land acquisition, ownership of the IRT infrastructure and broader transport

planning functions. The City will also be responsible for managing the performance of the Entity and ensuring that it complies with the standards set out in the SDA.
The City will be the sole shareholder of the Public Transport Entity and will ensure that everything it does is in accordance with the City's Integrated Transport Plan.

The City is also investigating the possibility of funding on an on-going basis some services, such as the cleaning and security services to be provided by the station services company, since these kinds of functions relate to core City functions to do with City property. This will remove these costs from the fare box, thereby allowing the system to offer more affordable fares to commuters. However, the Public Transport Entity should still manage the contractor providing these services.

2.1.2. The Public Transport Entity

Subject to the process issues, the main responsibility of the Public Transport Entity will be to manage the IRT system and ensure quality control of the services. The Public Transport Entity will have a decision role updating the initial routes and defining the routes, services and kilometres to be provide by VOs; but also a significant role in providing the conceptual design of new corridors and routes. The City is considering adding to the responsibilities of the Public Transport Entity further functions regarding public transport.

The Entity's activities include the bidding and tendering process for the contracts to the private operators that will provide the service (apart from the initial contracts, which will be handled by the City), as well as managing the contracts once signed. The Entity will also be in charge of scheduling and controlling the bus operations, developing quarterly, monthly and weekly daily basis schedule. The Entity will also be charged with the responsibility of managing the branding and image of the system, as directed by the City.

More detailed functions of the company will be defined in the service delivery agreement.
Subject to the completion of the required legal processes, the Public Transport Entity will be governed by a board of directors, all of whom will be appointed by the City. No councillors or city officials will be entitled to serve on the board. Instead, the board is likely to be made up of persons appointed in terms of their specific expertise and experience. The Public Transport Entity will be run by a chief executive officer who will have a team of employees large enough to fulfil all the functions assigned to the Entity.

The offices of the Public Transport Entity will be include the facilities necessary for the scheduling and monitoring of the IRT vehicles, as referred to below.
Subject to completion and the outcome of the required legal processes, it is anticipated that the Public Transport Entity will be established in the last quarter of 2009. Upon its establishment, the initial contracts entered into by the City (referred to below) will be assigned by the City to the Public Transport Entity.

2.1.3. Vehicle operating companies

[Insert at appropriate place: No public transport operators should be licences to operate in competition to the IRT services; except that, where a service comes in from outside of the Phase 1A area, they should be allowed to continue.]
At the centre of the IRT system will be the vehicle operating companies (referred to below as the *VO companies*) responsible for operating the vehicles necessary to service both the trunk routes and the feeder routes of the IRT. For Phase 1A, the City will award contracts to two VO companies, both of which will be consortia established as private companies. The division of the required services between these two companies is discussed in paragraph #2.2, and the process of allocating the current industry actors to one or other of these companies in paragraph #2.7.

Both the VO companies will be appointed through a negotiation process to be run by the City, as described in paragraph #2.8. Each company will be contracted to provide both trunk and feeder services and the contract will be paid by way of a fee per kilometre of service provided. The VO companies must ensure that the amount that they are paid per kilometre is sufficient to cover total operational costs, plus a reasonable rate of return on their investment, which is a core element of the negotiation between the City and these companies, and eventually the companies' bids.

Mechanisms for procuring and payment of vehicles to be operated by the VO companies are discussed in paragraph #2.3. The VO companies will use the vehicles solely for purposes of fulfilling their obligations to the Public Transport Entity for the life of the contract, at which time they will be able to dispose of the asset.
The VO companies must be ready to test and train the drivers at least two months in advance of the system opening and will need to work with the Public Transport Entity on coordination of vehicle procurement, infrastructure construction, and system opening.

In terms of these obligations, each VO company will be responsible primarily for operating feeder vehicles on feeder routes and trunk vehicles on specified trunk routes. The routes are described in Part III. The detailed programming of services to be provided on the routes and frequency of services will ultimately be determined by the Public Transport Entity, in consultation with the VO companies, subject to the terms of their contracts. The

final payment of kilometres will be subject to deductions for fines for non-compliance of quality of service as set out in paragraph #2.6.

Feeder routes falling within the Contract Area (see paragraph #2.2) of a given company will be assigned to that companies. The contract will give nonexclusive rights to the companies on the trunk routes and they may be required to operate on any route within IRT as determined by the Public Transport Entity.
On leaving the depot the vehicle will be under the control of the Public Transport Entity, which will also have direct contact with the driver.

The depots will be owned by the City and provided at no cost to the operator. The depots will be provided with all fixed infrastructure such as buildings, parking areas, maintenance pits, wash bays, fuel tanks, fencing, service connections, etc. The operator will be responsible for the maintenance of the depot and for the supply of all the required staff and equipment such as tooling, office equipment, and payment for all services such as water, electricity, etc, as well as security.

The space and buildings for the administrative offices of the companies, and the maintenance yards will be provided at the depots but owned by the City. All of the equipment, furniture, maintenance tools and other costs associated with outfitting the depots will be borne by the operating companies. The City will be responsible for providing all the utility connections such as water, electricity, telephone etc. but the user charges will the responsibility of the VO companies.

The City remains responsibility for insurance of the infrastructure it provides, and the operator for all its equipment. Each of the vehicles will be fitted with the necessary equipment to enable the Public Transport Entity to schedule their departure and arrival times at particular points and to monitor their movement, such as GPS transponders and on-board computers. The scheduling and monitoring equipment will also be utilised to ensure compliance with the requirements stipulated by the Public Transport Entity. This equipment will be provided for through the control centre contract (see paragraph #2.5).

The VO companies will be responsible for the maintenance of the vehicles. The VO companies will be fully responsible for driver management. The Public Transport Entity will specify the training requirements and carry out regular checks and examinations. The VO companies will not be responsible for fare collection in trunk service; but they will be responsible to take steps regarding fare evasion on feeder buses. For trunk vehicles fare collection will occur only on the stations through the use of smartcards, and not in the buses. For feeder services, the buses will have turnstiles and smart card readers on board, and that equipment will initially be provided by the fare system company. Feeder vehicles will have electronic cash boxes where passengers without smart cards could pay the fare, but the driver will not manage cash. The VO company will then be responsible for procuring any replacement equipment needed for the fare collection system or for operational control.

The VO companies will not manage the process of advertising on vehicles, since such advertising will be used for providing income to the system as a whole, and managed by the Public Transport Entity or a company contracted for this purpose by the Entity. The VO companies must allow access to vehicles to the Entity and advertising service providers, within the limited and specified spaces in the vehicle set aside for this, and facilitate installation of facilities for infotainment.

The vehicle operating contracts will be for a specified duration. The duration will be for a set maximum average number of kilometres for the fleet, or 12 years, if the maximum average kilometres have not been reached by that stage. The maximum average number of kilometres for the fleet has not been finalised, but will be at least 850 000 kilometres per trunk vehicle, and a set number of kilometres for feeder vehicles. The life of the contract will correspond with the expected commercial life of the 18 meter articulated trunk vehicles, up to a maximum of 12 years, subject to the confirmation of the legality of this possibility.

2.1.4. The fare system company

Passengers will travel using smartcards, which they can purchase and subsequently top-up at stations or at retail outlets.
A fare system company (FS company) will be contracted by the City and will be responsible to create and operate a simple, effective, efficient and transparent fare collection system. This company will need to supply the fare system (both hardware and software), to order and supply smartcards, to procure a network of retailers to sell smartcards and to top-up of funds on smartcards off the stations, to supply fare transaction data to the City and to provide additional services such as training, maintenance, software upgrades, etc. The FS company will need to provide timely and accurate information about daily fares collected and any other relevant commuter information as requested by the Public Transport Entity for decision making and planning purposes. The CC company will be responsible for maintaining the above system.

The FS company will be responsible for establishing and enforcing the day-to-day management of the fare collection function and will have to adhere to the system's goals for good customer service and experience.

2.1.5. The control centre company

The City will enter into a contract with a control centre company (CC company), which will be responsible for the supply of the fleet management system (both equipment and the software), the supply of CCTV systems (cameras, terminals and software), the supply of an information display system (control terminal, in vehicles and station displays and software) and the provision of various services such as training, maintenance, software upgrades, etc. It will also have to install other equipment on the vehicles, such as the GPS transponders and on-board computers. It will be required to set up and equip the control centre and making sure there is smooth communication between all. The CC company will be responsible for maintaining the above system.

The Public Transport Entity will be doing the actual control and scheduling of the bus services, and the CC company will enable the Public Transport Entity to fulfil its scheduling, monitoring and control functions. The CC will operate the control centre during the first four months of operation, besides during the World Cup Services, in a testing-training period to the IRT officials.

2.1.6. Station services company

A single contract will be entered into with the station services company.
The station services company will be responsible for general services on the stations and for upholding the IRT system's quality goals of good customer service and experience. It will supply a communication system linking security personnel and the control centre. It will principally be responsible for security on the vehicles and the stations.

The station services company will be responsible for hiring and training cashiers and customer service agents at the stations and providing a level of service that exceeds customer expectations. While the fare system company is responsible for procuring, installing, and maintaining the equipment in the stations for fare collection, the station services company will need to coordinate with the fare system company for maintenance and upkeep of the fare collection equipment within the station.

It will be responsible for security in the station, for both passengers and the money collected from ticket sales. This includes controlling fraud and fare evasion. The company is liable for any money lost or stolen and will ensure deposits are made from the station to the Public Transport Entity's account. They will also be responsible for the cleaning of the stations and for minor maintenance of the stations. (Major maintenance will be the responsibility of the City.)

2.1.7. Non-motorized transport (NMT) feeder system operator

The IRT stations will be designed to encourage people to reach the stations by walking, cycling, and non-motorized pedicabs, although similar small motorized cabs may also be considered in hilly areas or where pedicabs are not practical for other reasons. The City will provide the necessary parking and infrastructure for the following services: procurement and maintenance of for-hire pedicabs, procurement and maintenance of rent bicycles, and secure bicycle parking.

The pedicabs will serve as feeders to the trunk lines and will be integrated to the operations of the IRT system. It is preferable that these kinds of services are contracted to the VO companies. The non-motorized pedicabs are emission-free and their lower speed reduces risk of accident. They will complement the service provided by the feeder buses, increasing the coverage and improving the whole system's service and operations. Pedicabs feeders, as experienced in Bogotá, can reduce the cost of the vehicle operators by serving areas with very low demand at a much lower cost of operations than a bus, which will also be reflected in a better service for the customer. Since the Pedicabs will be integrated with the IRT system, they will have exclusive rights to access the stations and park in the designated areas. The pedicabs will be stored in the depots already provided for the vehicles.

Bicycle rentals will be an integrated part of the system, however this system will not be part of the vehicle operations contract.